MANUAL

OF

SURGICAL ANATOMY.

A

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OF

SURGICAL ANATOMY,

CONTAINING A MINUTE DESCRIPTION OF THE PARTS CONCERNED IN OPERATIVE SURGERY, WITH THE

ANATOMICAL EFFECTS OF ACCIDENTS,

AND INSTRUCTIONS FOR

THE PERFORMANCE OF OPERATIONS.

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TRANSLATOR'S PREFACE.

The science of anatomy has been usually divided into several branches, corresponding to the different systems of which the body is composed; as, for instance, into osteology, which comprehends the description of the various bones constituting the human skeleton; myology, the doctrine of muscles; neurology, that of nerves, &c. This division is sufficiently well calculated to convey to the student distinct ideas of the structure and organization of the human frame, [illegible] ce to that connected view of the different [illegible] ns in particular regions of the body, which is essential, as well to a correct diagnosis of accidents and [illegible] diseases, as to the performance of surgical operations. Anatomy, as it is taught according to the common mode, may, indeed, be considered as an abstract science: for although the student may be acquainted with the bones, muscles, arteries, nerves, &c. of the body, considered apart from each other; yet, if he be ignorant of their relative situation and connexion, his knowledge will be wholly unavailing for any practical purposes. It has been observed, for example, that the student who has been shown the distribution of the venous, arterial, and nervous systems of the arm, does not, therefore, necessarily know how each of them lies with respect to the other at the bend of the elbow; and if he be ignorant of

their relative situation, he cannot know how to pass a ligature round the artery, without at the same time including its accompanying nerve. These considerations have led to the adoption of a mode of studying anatomy, in which the body has been divided into separate regions; the various component parts of which are successively investigated, according to their natural arrangement. This has been called by the continental writers the *anatomy of regions.* The number of regions into which the body may be divided, in pursuance of this system, must, to a certain degree, be arbitrary; but in the following treatise it has been attempted to limit them, in such a manner as, on the one hand, to ensure perspicuity, and on the other, to avoid unnecessary repetitions.

The work, which may be considered as the germe of this *Manual,* is a Treatise on Surgical Anatomy, by Mr. Colles, Professor of Anatomy at Dublin, the first and only part of which was published in 1811. The plan of this work was excellent, and the ability with which it was executed leaves us only to regret that the author did not extend it beyond the consideration of a few parts of the body. Dr. Edwards was engaged in completing this design of Mr. Colles, when the large work of M. Velpeau* made its appearance. M. Velpeau's work embraces the whole subject of surgical anatomy, but the plan of subdivision which he has followed, in distinguishing the different regions of the body, is too minute to be adopted in an elementary treatise.

* Traité d'Anatomie Chirurgicale, ou Anatomie des Régions. Paris, 1825. 2 vols.

The manual of Dr. Edwards, while it avoids tedious and complicated details, comprehends all that is most essential and instructive in the large treatise of M. Velpeau. It indicates the form, structure, and connexions of the different parts of the body, the knowledge of which is indispensable to the surgeon, and points out the influence which the anatomical arrangement of these parts exercises on the nature and treatment of the principal surgical diseases. It also enumerates the operations which the surgeon is called upon to perform in the different parts of the body, without entering minutely into the merits of the various plans which surgeons have recommended for their performance.

As this Manual does not comprehend the description of *all* the parts of the body, but only such as are concerned in accidents, surgical diseases, and operations, it is obvious that it will not supersede the necessity of studying such elementary works as contain detailed and separate accounts of the different systems of the body.

To the more advanced student, however, and to the practitioner, this work, it is presumed, will be found of no inconsiderable importance, since it will point out to the former the application of the science, of which he may have only acquired the dry details, and recall to the mind of the latter those details which time may have partially effaced from his memory, in connexion with such points as are of daily occurrence in practice.

The only works in the English language, upon the plan of this Manual, are those of Mr. Colles of Dub-

lin, and Mr. ALLAN BURNS; but these, however ably executed, are confined to the consideration of only a few parts of the body; that of BURNS, indeed, only to the head and neck. The reception which these works have experienced in this country, and the success which has attended similar publications on the continent, afford the best proof of the general utility of the design, and the strongest assurance that this translation of Dr. EDWARDS's Manual will not be unacceptable to the profession.

WILLIAM COULSON.

59, *Aldersgate Street,*
October 1, 1827.

TABLE OF THE CHAPTERS.

MANUAL

OF

SURGICAL ANATOMY.

CHAPTER I.

SUPERIOR REGION OF THE HEAD.

§ 1. THERE are no natural limits which separate the superior region from the other parts of the head; thus, in order to circumscribe it, we draw a line round the cranium, and this is made to pass on the tuberosity of the occipital bone above the ear, on the external orbitar process of the os frontis, and immediately above the eyebrows and the root of the nose. The portion of the head thus circumscribed, represents the half of an ellipsoid, the largest part of which is situated posteriorly: its circumference may be compared to the segments of two circles, which, according to CAMPER, vary from each other about one ninth. The proportion of the segment of the lesser circle to that of the greater, varies at different periods of life. In children, according to Soemmering, it is as 3 to 4, or 2 to 3, and in adults as 30 to 31. The anterior part of the calvarium increases much more in circumference with the growth of the body, than the posterior. The anterior part of this region is called the forehead: it is convex, and presents on each side of the median line a rounded projection called the frontal tuberosity. The obtuse angle, formed by the external orbitar process of the frontal bone, separates inferiorly the forehead from the sides of the head, which are flattened, and known by the name of *temples*. The tuberosities on the parietal bone are large and rounded eminences, situated on the

upper part of the head, above, and a little behind the ear. Lastly, behind these projections, and on the median line, there exists in general a slight flattening, which corresponds to the upper part of the occipital bone.

§ 2. The integuments which cover the forehead are not very thick, and do not serve for the growth of hair. In youth they are smooth, but, as persons advance in age, they present, in general, transverse furrows. The skin at the inferior and anterior part of the temples is still finer and smoother; that at the upper and posterior part of the head is, on the contrary, very thick, of a serrated texture, and not very yielding. It contains the roots of hair, and a great number of sebaceous follicles. Each hair has a distinct capsule for itself, within which several sebaceous follicles are also situated; these are arranged in the form of a crown, or circle, round the root of the hair. The direction in which the hairs are implanted seldom varies: towards the depression which we have mentioned, as corresponding to the superior angle of the os occipitis, they stand nearly vertical; but, below this point, they penetrate the skin obliquely downwards.

§ 3. Immediately under the skin there is situated a thin layer of a lamellated texture, containing some very fine and serrated adipose cells, excepting at the inferior part of the temples, where we find a thick layer of fat. In all the other parts of this region the subcutaneous cellular tissue is thick, serrated, and closely unites the skin to the parts situated beneath. This arrangement contributes to render this thick and resisting membrane still less yielding: thus, for instance, when inflammation shows itself in this part, it always assumes the erysipelatous character: collections of pus form in it only in very rare cases. The small tumours which develope themselves in its substance, frequently assume a flattened shape, from which circumstance they have been vulgarly called moles. Thus the edges of wounds with loss of substance can be united but with great difficulty, and these injuries are seldom healed by the first intention. Union of these wounds will be difficult, or otherwise, according to the quantity of substance lost,

and the depth to which they extend. If there be much loss of substance, or if the fascia situated beneath the skin be divided, their union by the first intention will not be effected; but if, on the contrary, neither of these circumstances has occurred, then this union will take place. It is at the superior and posterior part of the head that the most intimate union of the scalp with the cellular tissue, and of it with the parts beneath, exists: on the temples this union is not so firm. Indeed, the cellular membrane, which at the top of the head is placed immediately under the skin, and, to use the expression, is continuous with it, forms in this part a fibro-cellular layer, to which the name of the superficial fascia of the temporal region has been given, and which is separated from the integuments by a layer of loose cellular tissue.

§ 4. In the substance of the subcutaneous cellular layer, we find a considerable number of blood-vessels, which anastomose together, forming, in the whole extent of this region, a very complicated net-work.*

On the top of the head the veins communicate so intimately with each other, that it would be difficult to determine to which trunk the greater number of them belong. We will, therefore, only at present state, that the principal subcutaneous branches which arise from this net-work of veins are—1. *The frontal vein.*—This vessel, frequently a single trunk, but sometimes double, and at other times altogether wanting, occupies the median line of the forehead, and descends towards the root of the nose, to reach the facial vein. It is situated between the skin and the subcutaneous cellular tissue, of a considerable size, particularly in old people, and is accompanied by no arterial trunk. 2. *The superficial temporal veins*, formed by an anterior branch coming from the forehead, and by a posterior one which arises

* The vessels of the head and face may be divided into the superficial and deep-seated, each set forming a very fine and distinct net-work. In the anatomical museum belonging to the university of Berlin, there is a head, on the dissection of which much time and labour were spent by the prosector, M. Schlemm, in which these two sets of vessels are better represented than I ever saw them elsewhere.—T.

on the upper part of the occiput, and the superior region of the ear. 3. *The superficial occipital, or posterior auricular vein:* it receives the branches coming from the posterior parts of the head, and empties itself sometimes into the external, and at others into the internal jugular vein. The veins of this part contribute also to form some other trunks; but, as they are situated more deeply, we will defer speaking of them for the present.

The arteries which ramify under the integuments of the superior region of the head are the frontal, the supra-orbitar, the superficial temporal, the posterior auricular, and occipital arteries. The *frontal artery* is one of the terminating branches of the ophthalmic, and ascends from the internal angle of the orbit towards the top of the head. It is at first situated deeply, but soon divides into several branches, which become subcutaneous, and ramify on the anterior and superior parts of the head, where they anastomose with branches of the same artery on the opposite side, as well as the superficial temporal, and are distributed to the muscles and integuments. The *supra-orbitar* artery also arises from the ophthalmic: it leaves the orbit through the supra-orbitar foramen, and, after going some way under the muscles of the forehead, it gives off a few branches, which ramify on the integuments, and anastomose with the frontal and superficial temporal arteries. The *superficial temporal* is a continuation of the external carotid, and is situated on the side of the head, immediately in front of the ear. It is at first lodged in the subcutaneous cellular tissue, between the superficial fascia and the subjacent plane of muscles, but its branches very soon dip down into the lamellated, dense and resisting structure of which we have already spoken. The anterior branch of this artery goes upwards and forwards, and frequently anastomoses with the temporal of the opposite side, and the frontal and infra-orbitar arteries, and ramifies in the skin and muscles of the front and top of the head. The posterior branches communicate frequently with those of the opposite side, and with the superficial occipital artery.—It is the trunk of this artery which is generally selected for the operation of arte-

riotomy, on account of its superficial situation, as well as the resisting plane on which it is situated, and which allows of its being easily compressed.* The *posterior auricular* arises from the external carotid, and, as its name implies, is situated behind the ear; it takes a course upwards and backwards, and contributes to form the subcutaneous net-work of vessels. Lastly, the *superficial occipital artery* comes from the same trunk, and proceeds between the integuments and the epicranial aponeurosis to the top of the back part of the head, where it terminates by numerous ramifications and anastomoses.

The cellular membrane, which incloses these arteries, is so dense and so closely united to the scalp, that the greater part of these vessels appear lodged in the substance of the membrane. This arrangement gives a particular character to wounds of these ves-

* The anterior branch is the one usually selected for arteriotomy. Some have certainly recommended the trunk of the artery to be opened in preference; but on this subject we fully concur with the observations of Mr. Harrison, contained in his excellent work on the *Arteries*, vol. i. p. 56.—"If the student," says Mr. Harrison, "examine the artery near the zygoma, he will observe that it is covered for some extent by the dense fascia of the parotid gland; this covering is a cause of considerable difficulty in suppressing hæmorrhage when arteriotomy has been performed in this situation; and if pressure be applied sufficient to command the artery, a sloughing may ensue, which will occasion a troublesome and embarrassing secondary hemorrhage; or it may give rise to alarming erysipelatous inflammation, bringing the life of the patient into imminent danger. I have also known other unpleasant effects produced by opening the temporal artery near the zygoma, such as severe pain, both at the time of the operation, and afterwards, probably from a branch of the portio dura having been wounded, inflammation extending to the parotid gland, or meatus auditorius, and sometimes terminating in tedious abscesses, &c. &c.; and as the artery is here partly covered by some veins which may be wounded in the operation, a varicose aneurism may be formed; for these reasons, I should advise the student against the practice of indiscriminately opening the temporal artery near the zygoma." The temporal and occipital arteries are sometimes the seat of aneurisms; the latter artery, however, more rarely than the former. There is a good representation of an aneurism of the occipital artery, which occurred in a woman, sixty-three years of age, in an inaugural dissertation by Seilbach, (Jena, 1824.)—T.

sels, and often renders the application of a ligature on them very difficult. Indeed, when an artery lodged in the loose and fatty cellular tissue is opened, the blood escapes into the cells of the tissue, and forms a deep-coloured mass, having a porous appearance similar to that of the placenta, from which the blood escapes as from a sponge. But if, on the contrary, the wounded artery is situated in the midst of muscles, or is lodged beneath the scalp, the effusion of blood is circumscribed, and soon becomes surrounded by an exudation of plastic lymph. It sometimes happens, then, that the albuminous matter, in becoming solid, forms, on the opening of the artery, a kind of tube or hollowed elongation, through which the blood circulates. A knowledge of this circumstance, which has been observed by Morgagni, Jeffrey, Burns, and others, is important in practice, for this albuminous prolongation is neither sufficiently strong to support a ligature, nor sufficiently organized to take on the adhesive inflammation; thus, when hæmorrhage is to be stopped by means of ligatures, this prolongation must be detached with the handle of the scalpel, and great care taken to place the thread on the extremity of the artery itself.

Some lymphatics, the arrangement of which presents nothing remarkable, accompany the veins that are spread out under the scalp, and anastomose intimately with each other.

§ 5. There exists also in this region a great number of nervous filaments, situated immediately beneath the skin. Some twigs, coming from the internal branch of the *frontal nerve* and the external branch of the *nasal nerve*, are distributed under the integuments and ascend to the top of the head. This is the same with some filaments of the *supra-orbitar nerve*, which penetrate the epicranial aponeurosis, and the frontal muscle, and become subcutaneous. Some branches, coming from the cervical plexus and the facial nerve, are situated on the side of the head, together with the *superficial temporal* branch of the fifth pair, which ascends, at first, behind the artery of the same name, and then divides into a great num-

ber of filaments, which, anastomosing with the temporal branches of the frontal nerve, constitute the temporal plexus. Lastly, on the back part of the head, we find some filaments of the posterior auricular nerve, and numerous branches coming from the occipital nerve, which arises from the second cervical pair. The branches of these different nerves frequently anastomose with each other, and follow in general the course of the arteries. Their considerable number, and the density of the subcutaneous cellular tissue, in which they are situated, render all punctures of the scalp very painful; wounds of these parts are frequently followed by very violent inflammation.

§ 6. Immediately below the parts which we have just enumerated, there is situated a musculo-aponeurotic layer. The *epicranial aponeurosis*, which forms the greater part of it, occupies the top of the head; it is thick, resisting, of a dense and serrated texture, and closely connected to the common integuments by some intermediate cellular membrane. Towards the upper part of the forehead, it gives attachment to the *frontalis* muscle, and degenerates then into cellular tissue. The fibres of the frontalis muscle descend obliquely outwards towards the nose and the eyebrows, and become mixed with the orbiculares palpebrarum, the corrugatores superciliorum, and the pyramidales nasi. It is intimately united to the skin of the forehead, and on its action the formation of the transverse folds seen in this part depends. On the sides of the head the epicranial aponeurosis becomes thinner, and terminates in the superficial fascia. Here it gives attachment to the fleshy fibres of the anterior auricular muscle, which converge towards the helix, and to those of the superior auricular, which are fixed inferiorly to the concha of the ear. Lastly, at the posterior part of the head this aponeurosis terminates in a quadrilateral muscle, which is attached to the superior ridge of the os occipitis, close to the temporal; it is the *occipital.*

§ 7. Throughout the whole extent of the superior region of the head, excepting at the temples, this mus-

culo-aponeurotic layer is only separated from the pericranium by loose and slightly serrated cellular tissue. This arrangement, together with the resisting texture of the aponeurosis, accounts for pus never collecting in great quantities between this membrane and the pericranium, but, on the contrary, infiltrating itself and readily extending to a very great distance. The posterior surface of the frontal muscle rests on the bone of the same name, and also covers in part the corrugatores superciliorum and temporal muscles. The supra-orbitar artery, vein, and nerve proceed for a short space under the frontal muscle and the superior portion of the orbicularis palpebrarum, before they become subcutaneous. This is also the case with the deep branches of the frontal nerves. In the temporal fossa, below the parts which we have before enumerated, we find an oval-shaped aponeurosis, which is attached to the curved line of the temporal and frontal bones, and which descends towards the zygomatic arch. This membrane is thick at its superior part, but inferiorly it divides into two layers, which are separated by a quantity of fat and cellular membrane. The *deep temporal vein*, the branches of which are situated just beneath the skin, pierces this aponeurosis, and then goes downwards and backwards, describing numerous turns on its internal surface. The space comprised between this aponeurosis and the bone is covered by the *temporal muscle.* The fleshy fibres of this muscle are attached to its upper part; they descend obliquely on the two surfaces of an aponeurosis, which separates them into two layers, and terminating in a thick tendon, go to be inserted into the lower jaw. At the anterior part of the temporal fossa we find the *arteria temporalis profunda anterior*, which, arising from the internal maxillary artery, ascends vertically to be distributed in the substance of the muscle. The *arteria temporalis profunda posterior* takes the same origin, but goes between the temporal muscle and bone, to which, as well as to the periosteum, it is distributed. The *anterior and posterior deep temporal nerves*, which arise from the inferior maxillary nerve, also ascend

into the substance of the muscle, and are there distributed.

§ 8. The bones which form the arch of the cranium are the frontal, the parietal, the temporal, and occipital. Their external surface is in general smooth, and the periosteum which covers them, and which is named pericranium, adheres but slightly to it, excepting at the posterior part of the head and in the course of the sutures. These bones are formed of two lamellæ of compact tissue, separated by a tolerably thick layer of diploe, in the substance of which the veins ramify. These lamellæ are known by the name of external and internal tables.

The *frontal bone* occupies the anterior part of this region; in youth it is formed of two equal parts, which are united on the median line. At the inferior part of this line, the root of the nose is situated, and on each side are the superciliary ridges, bounded externally by the external orbitar processes. These eminences, which, on account of their situation, are very much exposed to fractures, establish the limits between the forehead and temporal fossæ, and are continued superiorly with the curved line to which the temporal aponeurosis is attached. Lastly, the frontal tuberosities form a projection of greater or less size towards the superior part of the forehead, and thus cause a kind of sulcus between them and the superciliary ridges. Behind the root of the nose there exist, in the substance of the bone, two cavities, named *frontal sinuses*. They are in general separated from each other on the median line by a vertical partition, and open inferiorly into the nasal fossæ. Their interior is lined by the mucous membrane of the nose. When a portion of the anterior parietes of these sinuses has been removed, a discharge takes place from the wound similar to that which results from the suppuration of the brain; and when, in a case of this kind, the whitish membrane which lines these cavities has not been torn, the act of respiration communicates to it a kind of movement which resembles that of the dura mater; thus it is possible to confound this accident with a complete fracture of the cranium, and to conceive that the brain has been wounded, an instance of which

mistake is recorded in the second volume of the *Mémoires de l'Académie de Chirurgie.* In children these sinuses are not found, or at least are but little developed; but it seldom happens that they are wanting in adults. In old persons they extend sometimes as far as the external orbitar processes. Lastly, they have a triangular form, and are much larger inferiorly than at their upper part. This circumstance might render the operation of trephining very difficult in this point; for the two tables of the frontal bone not being parallel to each other, the internal parietes of this sinus might be cut through in its upper part before the lower part be touched.* Thus, in order to avoid the occurrence of this accident, we should, for the purpose of dividing the internal table, use the crown of a trephine much smaller than that which is used for the external table. The existence of the *processus cristæ galli* of the ethmoid, near the internal surface of the frontal bone, behind the frontal sinuses, is also one of the reasons on account of which it has been advised not to apply the trephine at the inferior part of this bone. Indeed, the projection formed by this crista is sometimes so considerable, that before it can be cut the frontal bone will have been divided in its whole thickness; from which circumstance the dura mater, and even the brain itself, would be exposed to the risk of being torn.

The *parietal bones*, one on each side, are quadrilateral, smooth, and convex, situated at the upper part of this region; above and behind are placed some openings, which give passage to veins having no valves, and

* The frontal sinuses are not formed by the separation of the tables of the skull, but have their proper bony parietes. The bony partition, which, by-the-by, does not always divide the two sinuses into equal parts, is composed of two layers; and the sinuses seldom communicate with each other by a foramen in the septum. They consist internally of several cells, which communicate with each other. The opening of each sinus lies behind the incisura nasalis of the frontal bone. From this a canal proceeds downwards, through the anterior parts of the labyrinth of the ethmoid bone, closed externally by the os unguis and the frontal process of the superior maxillary bone; internally, by the plate formed by the superior and middle concha of the ethmoid bone.—*Vide Blumenbach de Sinubus frontalibus, Goett.* 1794. 4.—T.

which establish a communication between those of the dura mater and the pericranium. These are called the venæ emissariæ of Santorinus. In the middle part of these bones the parietal protuberances are situated; lastly, we may observe below a curved line continuous with that of the os frontis, and superiorly circumscribing the temporal fossa. Below this projecting line, which gives attachment to the temporal aponeurosis, thé parietal bone is in connexion with the temporal muscle; but above it is covered by the common aponeurosis. It is at the middle and posterior part that this bone is thickest, and at the anterior and inferior angle that it is the thinnest. In this point we find, on its internal surface, a deep sulcus, which is sometimes converted into a canal by a thin piece of bone, and which lodges the anterior branch of the middle meningeal artery. It is from this circumstance that trephining on the anterior and inferior angle of the parietal bone has been discouraged, for the artery may be divided before the bone has been sawed through. But if the case requires trephining, the fear of hæmorrhage ought not to deter the surgeon from performing the operation, since it would be easy to stop it by passing under the cranium, in the points corresponding to the artery, a small metallic plate, bent and armed with agaric; or by filling the opening made with the trephine by a cork, with a perforation in its centre.*

The *temporal bone*, also one on each side, is situated at the middle and lateral part of the head; but it is only a small part of its squamous and mastoid processes that contribute to form the superior region. The squamous portion is very thin, and consequently often the seat of fractures; its external surface is flat, or slightly convex, smooth, intercepted with a few sulci, and gives attachment to the fibres of the temporal muscle. The mastoid process is, on the contrary, rough and very

* {Where the middle artery of the dura mater is lodged in a canal in the bone, and the trephine is applied over it, it must necessarily be divided: under these circumstances, the introduction of a plug of soft wood will suppress the hæmorrhage. In other cases, when the vessel is not intimately connected with the dura mater, it may easily be tied with a needle and ligature.—W.}

thick, and is situated behind the former. We shall have occasion to treat of it more in detail when speaking of the auricular region. This is also the case with a small portion of the ala of the *sphenoid bone*, which is situated between the frontal, temporal, and parietal, and which contributes to form the temporal fossa.

The *occipital* terminates posteriorly the roof of the skull: the protuberance which is situated on the external surface of this bone, and the two curved lines which extend laterally towards the temporal, terminate, as we have already remarked, the posterior region of the head.

The *sutures* which the junction of these bones forms, are, 1st, the coronal or parieto-frontal, which is transverse, and situated near the anterior third of the head; 2nd, the fronto-sphenoidal, which is the continuation of the preceding; 3d, the parietal or sagittal, which occupies the median line of the vertex, from the transverse suture to the three posterior fourths of the head; 4th, the occipito-parietal, which, commencing at the termination of the sagittal, and proceeding from the median line to the basis of the cranium, on account of its form has been called the lambdoidal suture; 5th, the squamous, or temporo-parietal, found at the lateral and inferior part of this region; 6th, the spheno-parietal, and spheno-temporal, which are situated at the inferior and anterior part of the temporal fossa.

A knowledge of the precise situation of these sutures is important; for many surgeons think that the trephine should never be applied over them. In truth, the dura mater, which lines the interior surface of the cranium, and which is fixed to it by means of fibrous bands and small vascular ramifications, adheres so firmly at these points, that the injury which renders the operation necessary rarely detaches it, and consequently, when operating in such situations, we are exposed to the danger of tearing the dura mater.*

* {Experience has proved that the trephine may be applied with equal effect and safety to any part of the skull, excepting at the basis; and we believe that very few surgeons now hesitate to apply it to any point, when the symptoms are sufficiently urgent.—W.}

Thus, when a fracture crosses a suture, we are advised to make an opening on each side of this line.

During infancy, the sutures have not the same structure as in the adult; for at that period the bones do not completely close the cranium, and thus membranous spaces of variable extent are left, where the angles of the bones tend to unite: these are named *fontanelles.* That which exists on the median line, at the union of the parietal bones, with the two portions of the frontal, is the largest. It is of a lozenge form, and is continuous with the sagittal, coronal, and transverse sutures, which unite there at right angles: sometimes it remains a long time after birth. The posterior fontanelle is much smaller, and has a triangular form; it is formed by the union of the parietal with the occipital bones, and receives the sagittal suture and the two branches of the lambdoidal; it usually disappears soon after birth. Lastly, we have a third fontanelle, above the mastoid process, between the occipital, parietal, and temporal; and a fourth, in the temporal fossæ, between the parietal, coronal, and sphenoid; they are small, and of irregular form. We easily perceive the pulsations of the brain through the great fontanelles; they yield readily to pressure; when they remain open too long a time after birth, encephalocele may supervene.

§ 9. The dura mater, which covers the interior of the cranium, is traversed in different points by venous canals situated in it, and into which all the veins of this membrane and of the brain empty themselves; they are called *sinuses of the dura mater.* The most important of these canals is the superior longitudinal sinus; it is placed on the median line, immediately under the bone, and extends from the crista galli to the occipital protuberance. In this place it unites with the lateral sinuses, which are the largest of all, and which describe a curved line going anteriorly and inferiorly towards the internal jugular vein on each side. The other sinuses of the dura mater have no important relations with that part of the cranium with which we are at present occupied; and we will only remark, that they all communicate together.

The fear of hæmorrhage resulting from opening these sinuses, has caused surgeons to condemn the application of the trephine over their course; but this is only applicable to the superior longitudinal sinus. Further, it is but rarely we have occasion to operate in these situations, and the flow of blood which results from the opening of one of these ducts is very slow, and easily arrested by the smallest pressure.*

The arachnoid, the pia mater, and the superior surface of the brain, which we find successively under the dura mater, do not present any appearance which need occupy us at present.

CHAPTER II.

ANTERIOR AND SUPERIOR REGION OF THE HEAD, OR NASO-ORBITAR REGION.

§ 10. The naso-orbitar region is circumscribed superiorly by the line which extends from the root of the nose to the external occipital protuberance, and serves as a limit to the superior region of the head; inferiorly by a second imaginary line, which, proceeding from the nostrils, joins the other before and above the ear. Anteriorly, it is bounded by the median line, and behind by a fourth line, which extends from the external orbitar process of the frontal bone to the anterior border of the masseter. In the front of this region, the nose is situated; it is perforated inferiorly by the nostrils, or external openings of the nasal fossæ, and above it a depression, of greater or less depth, is situated, separating it from the nasal projection, and called the root of the nose. At its superior part, the superciliary ridges are placed, which extend in the form of an arch, from the frontal protuberance to the external orbitar process, on each

* {The application of a dossil of lint over the orifice, will readily effect this object.—W.}

side, being immediately above the orbit, the cavity which lodges the eye. Inferiorly, this region is continuous with the cheek.

§ 11. The integuments which cover the nasal projection and the root of the nose are very thick, and united to the subjacent parts by a considerable quantity of thin and loose fatty cellular tissue. The integuments covering the superciliary arches present the same arrangement, but are, in addition, furnished with numerous dense hairs, directed obliquely outwards, and constantly moistened by an oily substance, a secretion from the sebaceous follicles which surrounds their roots. They describe a slightly-curved line, from the external orbitar process to the nasal projection, where they occasionally unite with those of the opposite side. The principal use of this row of hair is to prevent the perspiration which trickles from the forehead over the eye, irritating this important organ, and to protect it from the action of too strong a light. Below the eye-brows, we find the eye-lashes, which are separated from each other by a transverse opening, the internal extremity of which is the largest, and is called the great angle of the eye. The skin which covers these moveable curtains is fine, semi-transparent, and loose. We here observe a great variety of transverse folds. The cellular tissue, placed beneath, is very thin, always deprived of fat, and very easily infiltrated. The compression which the cheek receives from the application of the bandage, after the operation for hare-lip, suffices to show this phenomenon. Lastly, the falling of the superior eyelid is often caused by the lengthening and relaxation of the integuments of this part. On the free margin of the eyelids, the skin is continuous with the conjunctival membrane; these margins are rather thick, and are directed obliquely from before to behind, unless at the great angle of the eye, where they are rounded. At the spot where they begin to present this arrangement, we observe on each eyelid a small tubercle, in the centre of which is situated the orifice of the lacrymal ducts; to the outer side there is a row of small pores, which extends to the external

angle of the eye, and is formed by excretory canals from the glands of Meïbomius. In front of these there are rows of hard hairs, situated close to each other, and directed outwards, their bases being surrounded by small sebaceous follicles; these are called cilia: when, instead of being curved outwards, they are directed inwards towards the globe of the eye, then the complaint called *trichiasis* or entropeon ensues*. The margins of the eyelids, instead of being free, are sometimes adherent; their complete union, however, very seldom occurs, but a partial adherence, which most frequently takes place at the external angle of the eye, is much more common, and may be either congenital, or the result of variolous inflammation, burns, &c. In the majority of cases, an incision between the two rows of cilia, the adhesion of the cut surfaces being prevented, is sufficient to remedy this deformity.

The skin below the eyelids acquires a little more thickness; on the cheek bone, it reposes on a layer of dense, filamentous and fatty cellular tissue; towards the fossa canina, this layer becomes thicker, more loose, and more abundantly furnished with cells of fat. On the sides of the nose, it is, on the contrary, thin, resisting, and completely deprived of fat. The skin which covers this last part is fine and smooth; its reticular tissue is very distinct: and lastly, on the median line as well as the sides of the alæ nasi, it adheres very strongly to the subjacent parts.

§ 12. Immediately below the subcutaneous cellular tissue of the eyebrows we meet with the superior portion of the orbicularis palpebrarum, which is thin, but intimately united to the integuments; its circumference being continuous above with the occipito-frontalis, and a little before with the *pyrami-*

* There is another affection of these parts, called *distichiasis*, which signifies double row. Not that there is, properly, a double row of cilia, but there is a partial series of them produced on the inner margin of the lids, in addition to the natural rows of the cilia. (*Vide Lawrence's Lectures, Lancet*, vol. x. p. 328.) In their anatomical character, these cilia differ from those of the natural row by their extreme tenuity and whiteness.—T.

*dalis nasi.** This last muscle (if we may so express ourselves) is a prolongation of the occipito-frontalis, extends from the frontal tuberosity to the side of the nose, and is covered by the continuation of the frontal vein and the integuments. Below these two muscles the *corrugator supercilii* is situated; it is attached to the nasal tuberosity, and terminates in the skin towards the middle of the orbitar arch. Between and below these muscles we find some loose and laminated cellular tissue; it surrounds also the vessels and nerves which are distributed to this part, or which traverse it to go on the forehead. We also observe here *a branch of the frontal artery*—it proceeds horizontally towards the external orbitar process, and sends numerous branches to the forehead. Internally, the ramifications of the nasal and frontal nerves are distributed, and at a little distance from these, the branches of the supra-orbitar, and quite externally some branches of the temporal artery. These different parts rest on the frontal bone, which constitutes in this spot the superior margin of the orbit, the internal portion of which is rounded and projecting, and the external portion thin and sharp. We here observe a fissure, which is sometimes converted into a foramen, and which allows of the passage of the supra-orbitar artery and nerve. It is, generally, about an inch distant from the middle of the root of the nose, and in the projection of a line which passes between the first and second small molar teeth, and above the infra-orbitar foramen. It is essential to know the position of this foramen; for, in cases of tic douloureux of this nerve, it is generally divided at this point.

§ 13. Below the skin which covers the eyelids, we observe a layer of muscle formed by the *orbicularis*, whose fibres describe curves round the opening of the eyelids, and are attached, 1st, to the ascending process of the superior maxillary bone and internal orbitar

* The pyramidal muscle of the nose is not described by Albinus or Soemmering as a distinct muscle, nor do we find it in our Manuals of Anatomy; it is merely a prolongation of the *occipito-frontalis*, and contributes to give this muscle a point of support when it draws the integuments forwards.—T.

process of the frontal; 2d, to the anterior margin of the lacrymal duct; and 2d, to a small flat tendon, which is fixed to the internal head of this duct, and proceeds towards the internal angle of the eye, where it bifurcates, to be continuous with the fibro-cartilaginous substance lodged in the thick part of the eyelids. It is intimately connected by its posterior surface to a thin aponeurosis which covers the lacrymal sac. On the external surface of this muscle, we observe palpebral branches from the anterior ramifications of the temporal nerve, and veins of considerable size, which form a circle of vessels around the eye, and empty themselves into the angular vein at the root of the nose, and below the great angle of the eye, and into the superficial temporal veins. We also observe here some filaments from the temporal branches of the facial nerve and ramifications of the frontal. Lastly, at its superior part, it closely adheres to the skin; at its middle part, it is separated from it by very fine laminated tissue, and at its inferior part by the fat which extends on the cheeks.

§ 14. At the external part of both eyelids there exists a fibrous membrane, called *palpebral ligament*, which is separated from the orbicularis by lamellated cellular tissue: it proceeds from the angle of union of the cartilages of the tarsus, to the external border of the orbit, where it terminates, and is pierced by several small openings for the passage of nerves and vessels. The *cartilages of the tarsus* consist of small, thin, and flexible fibro-cartilaginous layers placed in the thick part of the free margin of each eyelid, on the same plan as the palpebral ligaments, from the lacrymal puncta to near the external commissure of these organs. Their anterior surface is convex, the posterior concave, and intercepted by the vertical sulci, which lodge the *glands of Meïbomius*, small rounded follicles, arranged one above the other, and secreting a sebaceous substance of a glutinous nature. The cartilage of the tarsus of the upper eyelid gives attachment, by its superior border, to the aponeurosis of the *levator palpebræ*. This muscle extends along the interior of the orbit, and in front it is only separated from the orbicularis by the palpebral ligaments; its paralysis is one of the causes of the com-

plaint called falling of the superior eyelid, or ptosis, a state which must not be confounded with spasmodic contraction of the orbicularis.

§ 15. The *inferior palpebral artery*, which proceeds from the ophthalmic near the internal orbitar process, descends almost vertically under the tendon of the orbicularis, and terminates by two branches, one of which is lost in this muscle, and the other proceeds outwards, along the inferior border of the cartilage of the lower tarsus. The *superior palpebral artery* has the same origin, and takes a similar course in the upper lid. These vessels anastomose with the palpebral branches, furnished by the lacrymal artery, and thus complete the arterial circle which surrounds the opening of the lids about four or five lines from their free edge. The veins of this part proceed either into the ophthalmic, or into the angular. Some of the lymphatic vessels go to the sub-maxillary ganglia, others to the parotidean ganglia; they present nothing worthy of notice. Lastly, at the base of the lower lid, the internal surface of the orbicularis rests on a layer of fat cellular tissue, which separates it from the inferior border of the orbit.

§ 16. Thus, as we have already said, we observe on the border of both lids, near the great angle of the eye, an aperture always open, directed a little backwards, and which is called the *lacrymal punctum*. The *ducts* of the same name, which border on it, and which appear formed by a prolongation of the conjunctiva, firmly adhere to the fibres of the orbicularis by which they are covered. They proceed, at first, one upwards and outwards, the other downwards, and also outwards; but they soon change their direction, acquire a greater size, and proceed inwards, converging towards each other. At the internal angle of the eye, they pass under the palpebral ligament, and open separately into the external and anterior part of the lacrymal sac. These ducts are destined to carry the tears from the surface of the eye into this reservoir; thus, when, by some cause, they cannot perform their functions, the patient is affected with an uncomfortable weeping. If this symptom depends on the obstruction of the ducts by collections of mucus, it is easily remedied by introducing a

probe from these ducts into the lacrymal sac, or by injecting into it plantin water; but it is not the same, when the epiphora depends on the obliteration of these canals, in consequence of adhesion of their parietes. In cases of this nature, A. Monro proposed to introduce a waxed thread, in the same manner as a seton, from the lacrymal sac into the ducts. A. Petit thought that it would be a better mode of proceeding to establish an artificial passage for the tears, by making an incision of three or four lines in length to the lacrymal sac, between the inferior lid and the globe of the eye, and by keeping a bougie introduced, till the edges became callous; but, at present, it is generally thought that all these operations are useless. In a few rare cases, we find a kind of fistula established between the inferior lacrymal duct and the internal surface of the lid. Lastly, Morgagni observed a considerable dilatation of the puncta and lacrymal ducts.

§ 17. Beneath the parts which we have just enumerated, the *conjunctiva* is situated; this is a thin and transparent mucous membrane, which lines the internal surface of the lids, and is reflected on the anterior surface of the globe of the eye. The cellular tissue which unites this membrane to the cartilages of the tarsus is thick and hard; but the nearer it approaches the place where the conjunctiva is reflected on itself, the looser it becomes. It is generally in the thick part of this layer that the small encysted tumours are developed which are so often found in this part. In fact, although these small tumours appear, at first sight, to be situated immediately under the skin, it is almost always between the conjunctiva and the cartilage of the tarsus that they really exist. In order to extirpate them, it is necessary that it should be done from the internal surface of the lids; sometimes, however, they are lodged between the orbicularis and palpebral ligament. In general, they are formed towards the free margin of the lids, and are of more frequent occurrence on the superior than on the inferior lid. These organs are also sometimes the seat of scirrhous tumours: when they are small, they can be extirpated in the same manner as encysted tumours; but when they occupy the whole substance of

the lid an operation would be unavailing, for it would occasion so great a loss of substance that this organ would not be able to cover the globe of the eyes, from which, symptoms would arise equally serious as those of the former complaint.

In the natural state, the skin which covers the eyelids and the part of the conjunctiva which lines them internally, bear such a relation in size, that the one does not tend to return on itself with more force than the other. But if one of these membranes becomes more elongated than the other, it forms a projecting swelling on the external or internal edge of the eyelid, and constitutes the disease called eversion, or inversion of the lid. In cases of eversion, or ectropion, the displacement of the portion of the conjunctiva which lines the internal edge of the lids may depend on relaxation of this membrane; but in general this depends on retraction of the skin, in consequence of cicatrization of wounds or ulcers of a considerable extent. The treatment, in this latter case, consists in cutting away the exuberant portion of the conjunctiva, and thus establishing the relative size which ought to exist between it and the skin.* When the case is inversion, or entropion, the cilia, instead of being directed outwards, are turned towards the globe of the eye, and continually irritate its surface.† In general, this misdirection of the cilia is accompanied with an inversion of the cartilage of the tarsus, and depends on cicatrization of extensive ulcerations of the palpebral conjunctiva; it sometimes also depends on morbid softening of the cartilage. In the first case, an operation similar to that which is employed in ectropion, will be found useful, and which consists in an excision of a certain portion of the skin of the lids.

* {The following operation, as practised by Sir W. Adams, will be found the most effectual. With a pair of sharp scissors, a portion of the lid, in the shape of the letter V, is removed from the external angle of the eye; the edges are brought together by a suture, and should be supported by a compress.—W.}

† {Dorsey and Saunders advise the entire or partial removal of the tarsus. The operation of Jæger, of Vienna, consists in dissecting off the anterior edge of the tarsus, and along with it the cilia.—W.}

§ 18. In front of the internal angle of the eye, and beneath the orbicularis palpebrarum, the *lacrymal sac* is situated; a small membranous sac, of an ovoid form, placed vertically in the depression which exists between the edge of the orbit and the tendon of the orbicularis. It is formed externally by a firm unyielding aponeurosis, fixed on every side to the edges of the lacrymal duct, with the periosteum of which it is continuous. The anterior surface of this aponeurosis is intimately united to the tendon of the orbicularis, some fibres of which are implanted into it; thus certain anatomists consider it as the reflected tendon of this muscle. Internally the sac is lined by a mucous membrane, of a reddish colour, and a soft and pulpy consistence, which adheres firmly to the bony parietes of the duct. Between these two membranes there is a middle tunic, thin and cellular. It is at the middle part of the external side of this pouch where the lacrymal duct opens; posteriorly it corresponds to the caruncle and to the conjunctiva; its superior extremity is dilated and rounded, and forms a slight prominence above the tendon of the orbicularis; lastly, its inferior extremity is continuous with the nasal duct. This duct is formed, like the lacrymal sac, of a cylindrical mucous membrane, which slightly adheres to the periosteum of the bony canal in which it is situated. This duct is formed by the os unguis, the ascending process of the superior maxillary bone, and the os spongiosum inferius. It is narrower in the centre than at its extremities, and descends from the depression which lodges the lacrymal sac to the inferior meatus of the nostrils, describing in its course a slight curvature, the convexity of which is situated forwards and outwards.

When, by any cause, such as enlargement or thickening of the mucous membrane of the nasal duct, concretion of the mucus secreted in the lacrymal passages, pressure exercised by a fungus of the maxillary sinus, &c., the passage of the tears across the duct is stopped, their accumulation in the lacrymal sac causes the dilatation of the anterior parietes of this pouch, and the formation of a tumour, varying in size, soft, indolent, of an oblong form, situated below the

great angle of the eye. When the tumour ulcerates and opens externally, it assumes the name of fistula lacrymalis. To put a stop to this malady, the natural passage of the tears must be re-established, and an artificial one produced. To fulfil the first of these indications, Anel introduced a very fine sound into the nasal canal by the superior lacrymal duct, and threw injections into it by the inferior lacrymal punctum. In this operation the lid is drawn a little to the inside for the purpose of exposing the punctum lacrymale, and giving the tube a direction approaching to that of the sac and the canals. A sound or probe is then introduced into it, by giving the instrument a direction first nearly perpendicular from above downwards, and from without to within, to introduce it into the sac. When it arrives at this point, it is held perpendicularly, and gently pushed into the nasal canal. This mode is frequently employed in England; but that which is most generally employed in France is a modification of the plan of Petit, in which the lacrymal sac is opened about a line below the tendon of the orbicularis (the exact situation of which is indicated externally by a whitish line), by passing the instrument from before to behind, and obliquely inwards, and approaching it a little to the superciliary edge, in order to make it penetrate into the nasal duct, where a metallic canula is introduced. With the same object, Laforest introduced a sound by the inferior orifice of the nasal canal, as we shall see in describing the nasal fossæ; and lastly, Pouteau opened the lacrymal sac by the internal surface of the eyelid, between this part and the eyelid. When it is wanted to make an artificial passage for the descent of the tears, the inferior part of the os unguis and the pituitary membrane require to be perforated* by the posterior surface of the lacrymal sac.

* {A simple perforation will not be sufficient for this purpose—the proper instrument to be employed is the *punch* (similar to that employed for making holes in leather) by which we cut out a small circle of bone and also of the lining membrane, so that a complete opening will thus be established to permit the passage of the tears.—W.}

§ 19. On the side of the nose, and in front of the great angle of the eye, we find, immediately beneath the skin, the *angular vein*, which arises from the frontal and palpebral veins towards the internal orbitar process, and takes a course downwards and a little backwards. Arrived near the inferior border of the orbicularis muscle, it goes still farther posteriorly, and assumes the name of *facial*. In this course it rests, in general, on the orbicularis palpebrarum, levator labii superioris alæque nasi, and levator labii superioris, and dips down under the zygomatic muscles; sometimes, however, this vessel passes beneath the common and proper levator muscles. In front of this vein, and under the branch which it sends to the back of the nose, *the nasal branch of the ophthalmic artery* is situated. This vessel leaves the orbit below the tendon of the orbicularis muscle, and descends on the external surface of the triangularis nasi, dividing there into a great number of branches, some of which anastomose with the ultimate divisions of the facial artery. The plane of muscle placed beneath these vessels is united to the integuments by a thin layer of thick serrated cellular tissue; it is formed by the pyramidalis, triangularis nasi, levator labii alæque nasi, and levator labii superioris. The first of these muscles is continuous superiorly with the frontal, and descends obliquely outwards, separating from its fellow in order to terminate in the subcutaneous cellular tissue on the side of the nose. A layer of aponeurosis, which is common to the two triangular muscles, covers the middle part of the nose, and is firmly united to it. The fleshy fibres of these muscles go horizontally outwards to terminate in a thin, short, and narrow aponeurosis on the canine fossa of the superior maxillary bone. Externally this muscle is slightly covered by the *common levator*, a thin, elongated, and triangular fleshy bundle, which is attached to the ascending process of the maxillary bone, below the tendon of the orbicularis, and terminates inferiorly in the ala of the nose and the substance of the upper lip. The *levator proprius* extends from the inferior border of the orbit to the lip. It is thin, flattened, and irregularly quadri-

lateral; it is connected externally with a portion of the orbicularis and the skin which firmly adheres to it; and internally, with the edge of the common levator muscle, and a great quantity of fatty, cellular tissue, which separates it from the *levator anguli oris* and depressor alæ nasi, and in the substance of which are lodged the vessels and *infra-orbitar nerves.* It is by an opening situated below the inferior edge of the orbit, and at the upper part of the canine fossa, that the superior maxillary branch of the third pair leaves the infra-orbitar canal, and goes to ramify in these muscles; it sends numerous filaments to all parts of the face, and, in anastomosing with the branches of the facial, forms a very complicated nervous plexus. The *infra-orbitar artery* follows the same course; it arises from the internal maxillary, traverses the infra-orbitar canal, and ramifies in the substance of the cheek, where it anastomoses with the facial arteries. The *levator anguli oris*, situated beneath these vessels and nerves, is attached to the middle part of the fossa of the same name, and near the inferior boundary of the naso-orbitar region, as we shall see on describing the upper lip. Beneath the parts, which we have just examined, we observe the eye, and the different organs contained in the orbit, and the orbit itself; and lastly, the bones and the cartilages which form the floor of the nose, and which divide in front the nasal fossæ.

§ 20. The *conjunctiva*, as we have said, is reflected from the internal surface of the lids on the globe of the eye, the anterior half of which is covered by it. On the edge of the cornea, its union with this membrane becomes so close, that it is impossible to demonstrate its presence farther, on which account several anatomists think that it ends here; but, in the rest of its extent, is connected in a very loose way to the globe of the eye. It is abundantly provided with capillary vessels, and receives its arteries from the ophthalmic. By injecting, with care, the eye of a fœtus not come to its full time, we see distinctly a great number of small arterial branches, which go from all parts of the conjunctiva towards the cornea, the twigs of which, in general cylindrical and all of the same size, anasto-

mose together, and form small arches which, in some places, are contiguous, in others separated, and by which a complete circle is formed around this membrane. These vessels are much finer in the adult, and it is to their existence that the rosy tint of the conjunctiva surrounding the cornea is owing, which we frequently observe in newly-born infants, and which might be attributed to a morbid state, if one were ignorant of this particularity, pointed out by Soemmering. In the healthy state, no branches are ever seen going from this net-work of vessels on the cornea, and no vascular communication can be discovered between the conjunctiva and this part; but this is not the case when the cornea becomes affected with opacity. We then always see on the white of the eye, and the part corresponding to the seat of the opacity, a small bundle of dilated veins, the radicules of which arise on the cornea.

§ 21. At the greater angle of the eye, the conjunctiva covers a small projecting body called the *caruncula lacrymalis*. It is formed of sebaceous follicles, united together by a small cartilage: some anatomists regard it as a third eye-lid in the rudimentary state. At its internal part there is a small muscle situated, recently discovered by Horner,* and which extends from the posterior border of the os unguis to the puncta lacrymalia: there is a diversity of opinion on its use.†

* The new muscle, which Horner of Philadelphia has discovered, is said by him to arise from the posterior edge of the os unguis, then divides into two portions, which are inserted into the eyelids close to the puncta lacrymalia. From this construction, it probably assists to close the lids on the globe, and draws the puncta towards the nose.—T.

† {Dr. Horner's claims to the discovery of this muscle have been very generally admitted. It is an interesting subject, and we may be permitted to select the following account of its uses from his System of Anatomy. "Its attachment to the posterior face of the sac is such, that it draws the orbital parietes of the sac away from the nasal, and dilates the sac, from the nasal face of the latter being fixed to the bones. As this muscle has a cylindrical concavity on its orbital side, it is evident that when it contracts the fibres become straight, or nearly so, like the fibres of the diaphragm, and the cavity of the sac is enlarged after the same manner as the cavity of the thorax. A tendency to a vacuum being thus produced by it, the valves or folds of the internal membrane of the

§ 22. The *globe of the eye* is placed at the anterior, and a little to the internal part of the orbit. The form is that of a spheroid, the greatest diameter of which (from ten to eleven lines) extends from before to behind. It is composed of several membranes, placed one over the other, forming between them cavities containing transparent humours. The cornea and the sclerotic constitute their external layer, the iris and the choroid the second, and the retina the third; lastly, the crystalline, capsule, and vitreous humours occupy the central part.

§ 23 (*a*). The *transparent cornea* is situated at the anterior part of the globe of the eye, and represents a segment of a sphere a little smaller than that of which the rest of the eye is formed, so that it slightly projects on the surface of this organ. The transverse diameter is much greater than its vertical, and its thickness is nearly the same throughout, excepting towards the circumference, where it becomes thinner, and terminates in a slope externally, by which it is united with the sclerotic. The internal surface is lined by a thin pellicle called the membrane of the aqueous humour, but which does not appear to contribute to the secretion of this fluid; and on its edge we observe a circular groove, which receives the iris and the ciliary ligament. Lastly, this tunic is formed of six layers,*

sac, permit the vacuum to be filled more readily through the puncta than from the nose; and the puncta being continually bathed in the tears of the lacus lacrymalis, both in the waking and in the sleeping state, the tears are constantly propelled through them by atmospheric pressure. The evacuation of the sac is no doubt accomplished by its own elasticity, and by the contraction of the orbicularis; probably in a chief degree by the latter, because in persons who have epiphora, or a tendency to obstruction in the nasal duct, the accumulation of tears and matter principally takes place at night, when the action of the orbicularis is suspended by sleep. For these reasons we should argue, that this little muscle is active all the time, both night and day."—W.}

* {The laminæ of the cornea are divisible into an indefinite number; it is to the abundance of its interstitial secretion, that the brilliancy of the eye during health is owing, and in consequence of its deficiency we have the dull, opaque appearance presented in some low states of fever, and in death.—W.}

united by rather loose cellular tissue, and which contain between them a limpid liquid.

In the operation for cataract by extraction, an opening is made across the cornea, through which the lens escapes. According to Beer's plan, the lower half of the cornea is divided about the eighth of a line from its circumference, the point of the knife being introduced into this membrane about a quarter of a line above the transverse diameter on the outer side of the eye, and brought a little higher up on the opposite side. In completing the section, care must be taken to direct the instrument perpendicularly downwards; for if it be turned a little forwards, the incision will be prolonged between the laminæ of the cornea, and the opening thus effected will not be sufficiently large to allow of the exit of the lens. According to Wenzel's plan, which M. Boyer employs, the section of the cornea is performed obliquely downwards, and from without inwards, for the purpose of not wounding the caruncula lacrymalis, which sometimes happens when the incision is made transversely. Lastly, in the operation of keratonixis, the lens is depressed by introducing a cataract-needle into the interior of the eye, through the centre of the cornea. But this mode, very much extolled by Langenbeck, is seldom employed in France.*

§ 23 (*b*). The *sclerotic*, with which the cornea is continuous, occupies nearly five-sixths of the circumference of the eye. It is a white, fibrous, shining membrane, solid and elastic. It is thinner than the cornea, and is also thinner anteriorly than posteriorly; but in this part it is strengthened by the expansion of the aponeurosis of the muscles of the eye which are inserted into it. At its posterior part it presents a large round aperture, and several small foramina, which give passage to the optic nerve, the central artery and vein of the retina. Also, in different points of its extent, we

* {We have performed the operation for cataract by means of a very delicate needle introduced through the cornea, as recommended by Mr. Jacobs, of Dublin; the capsule and lens on being cut up, were left to the action of the aqueous humour. We are disposed to give this operation a decided preference over that of Saunders and Adams.—W.}

observe the orifices of several small canals, crossed obliquely in its substance, and traversed by nerves and ciliary vessels. These vessels, before penetrating into the interior of the eye, ramify on the external surface of the sclerotic, and are intimately connected with it. The small arterial filaments, which are seen during life on the anterior part of this membrane, arise from branches of the ophthalmic, which pierce the fleshy and tendinous parts of the recti muscles, and go from four opposite points towards the cornea. Of these very minute arterial branches, those on the inner side of the cornea are the largest, the external ones being in general very small, and scarcely visible.

§ 24. Immediately beneath the external tunic of the globe of the eye, we find the choroid; it is situated behind and on the sides, and the iris in front. The *iris* is a membranous partition, placed vertically in the anterior part of the eye: it presents in the centre an opening capable of contracting and dilating, which does not exist before the seventh month of the fœtal life, and which is termed the *pupil*. The space comprised between the anterior surface of this membrane and the cornea, constitutes the anterior chamber of the eye, which is filled with aqueous humour. The posterior surface of the iris is covered with a black pigment, which is known by the name of *uvea*, and is in connexion with the ciliary body; lastly, its larger circumference corresponds to the ligament of the same name, and to the choroid. In the operation for cataract by extraction, great care should be taken to avoid wounding the iris; thus, the knife must be always directed parallel to this membrane, both in counter-punctuating the cornea, as well as completing the section downwards. It is for this reason that it is impossible to perform Wenzel's operation when the edge of the orbit projects very much, or when the globe very much recedes: for in such a case the operator would be obliged to direct the cutting edge of the instrument too obliquely in relation to the iris: the iris would then be endangered by the point of the knife passing through the sclerotic and vitreous humour. Another condition, equally important for the success of the operation, is that the

aqueous humour should not escape before the section of the cornea has been completed. When this happens, the iris falls forwards, and gets under the edge of the knife. It is for the purpose of avoiding this accident, that instruments should be always used whose thickness increases from the point to the handle, and in the use of which great care must be taken that they are introduced in a firm and gradual manner, and always kept in the same direction.

§ 25. The *choroid* corresponds to the sclerotic, and is united to it by very loose cellular tissue: it is thin, soft, of a brownish colour, and covered with a black matter called pigment. At its posterior part it is perforated by foramina, for the passage of the optic and ciliary nerves; anteriorly it is thickened, and forms a whitish ring, about a line in breadth, called the ciliary ligament. This ligament strongly adheres to the sclerotic, and is embedded in the middle of its anterior border in the circular groove on the internal surface of the cornea: it is also united to the iris, which in its turn, to use the expression, is embedded into it. It is in this spot that Scarpa proposed to perform an artificial pupil, by separating the iris by means of a cataract-needle, introduced through the sclerotic about two lines from the cornea; but this solution of continuity is always accompanied by an effusion of blood, which renders the aqueous humours turbid for some time. Moreover, this surgeon himself afterwards adopted Maunoir's plan. To the extent of about a line and a half from the internal border of the ciliary ligament, there may be seen, on the internal surface of the choroid, a great number of concentric folds; and to this radiated circle another smaller one succeeds, the folds of which are more marked, but less numerous: these are the *ciliary processes*, which, by their union in a circle, form what is called the *ciliary body*. They extend from the ciliary ligaments to the circumference of the capsule of the lens, to which they are adherent by their posterior border. Their anterior border is free, and rests on the iris, a fourth part of whose demi-diameter is occupied by them, as they proceed from the ciliary ligaments to the centre of this membrane. When, in cases of closure of

the pupil after the extraction of cataract, the operation for artificial pupil is performed according to Maunoir's plan, Scarpa thinks that this new opening ought to be made beyond the part of the iris which is thus in contact with the ciliary body; for its thickness, the abundance of its vessels, its want of contractile power, and the readiness with which it tumefies, would always render the success of the operation doubtful if the artificial pupil were opened too near the external border of the iris. According to this surgeon, the top of this triangular opening ought, at least, to correspond directly to the place which would have been occupied by the capsule of the crystalline lens.

In the operation for cataract by depression, a needle is introduced into the interior of the eye behind the iris, and in front of the crystalline. Hey and a few other surgeons have advised the sclerotic to be pierced at a little less than a line from its point of junction with the cornea, and a little below the transverse level of the diameter of the pupil; but as all lesion of the ciliary process is to be avoided with great care, the instrument had better be introduced a line and a half or two lines from this point, as recommended by Beer.

The choroid appears essentially formed of blood-vessels united by very thin cellular tissue. The arteries are principally distributed on its external, the veins on the internal surface, an arrangement by which two planes placed on each other are formed, of which the internal has been called *membrana* Ruyschiana. The arteries of the choroid are, 1. The *long ciliary*, generally two in number, one external and superior, the other internal and inferior. They take their origin from the ophthalmic, pierce the posterior part of the sclerotic, and proceed directly forwards between this membrane and the choroid as far as the ciliary ligament, where they divide each into two branches which anastomose together, and form an arterial circle on the border of the iris. It is for the purpose of avoiding a wound of the ciliary artery on the outer side, that in the operation for cataract by depression, Beer, Bertrandi, and others, recommend the needle to be introduced into the sclerotic at least a line below the level

of the transverse diameter of the pupil. Indeed, if the instrument were introduced in the course of this vessel, very serious inconvenience might arise, and if above it, some difficulty might be experienced in conveniently depressing the cataract. 2. *The short ciliary* vessels, which are sometimes twenty in number, ramify in the choroid immediately after their passage through the sclerotic. Their origin is the same as that of the long ciliary vessels. The veins of this membrane, which have received the name of *vasa varicosa*, on account of their tortuous course, empty themselves in the ophthalmic veins, as do also the long ciliary veins, which come from the iris, and follow the same course as the arteries of this name. The nerves of the iris, or ciliary nerves, arise from the ophthalmic branch of the fifth and the ophthalmic ganglion; they traverse the sclerotic behind the great diameter of the eye, proceed between this tunic and the choroid, pass under the ciliary ligaments, and reach the anterior surface of the iris.

§ 26. Behind the iris we find the crystalline, its capsule, the hyaloid membrane, the vitreous body, and, lastly, the retina. The *crystalline* is a soft and rounded body, and transparent in the natural state; its posterior surface is, in general, much more prominent than the anterior; its height and breadth are nearly double its thickness. It is contained in a thin, solid, and transparent membrane, called the *capsule of the crystalline*, and which, according to the experiments of M. Cocteau, may secrete the substance which forms the crystalline, a fact which accords very well with these results, viz. that the external layers of this body are very soft, whilst its central part is much harder. This capsule is formed of two sufficiently distinct parts, the anterior and posterior portions. Petit recommended the lesion of the first to be carefully avoided in the operation for depression; but if this direction were followed, a secondary membranous cataract would be almost sure soon to follow. Thus, Scarpa particularly advises that the anterior segment of the capsule should be divided and detached as completely as possible. In allowing the posterior part of the capsule to remain, the same inconveniences would not arise; for not only is it less subject

to become opaque, on account of the numerous vessels which are distributed on it; but, also, in the natural state, it is thinner than the anterior portion, and when it even loses its natural transparence, it is rarely that it is the cause of a total blindness. The anterior surface of the capsule only receives a few branches which come from the ciliary body; on the posterior surface, on the contrary, there are numerous ramifications of the central artery of the retina, which, arising from the ophthalmic and placed in the centre of the optic nerve, enters the globe with it, and traverses the vitreous body to arrive at this part; we also perceive here some veins which open into those of the choroid. Moreover, on depressing the crystalline deeply backwards and downwards into the vitreous body, this posterior portion of the capsule is always sure to be torn sufficiently to prevent its impeding the success of the operation by becoming thick and opaque.

§ 27. The capu!se of the crystalline is lodged immediately behind the pupil in a duplicature of the *hyaloid membrane.* The hyaloid is transparent, extremely fine, and forms a collection of cells which vary in their size and form, and in which the *vitreous humour* is contained, a soft, transparent, and gelatinous mass, which occupies the three posterior fourths of the globe of the eye. The anterior surface of the hyaloid membrane is in contact with the ciliary body, and leaves between it and the iris the breadth of about half a line, which is called the *posterior chamber of the eye:* this cavity communicates with the anterior chamber by the opening of the pupil, and is also filled by aqueous humour. In the rest of its extent, the mass, formed by the vitreous body and its membrane, is in contact with the *retina;** a medullary expansion of the optic nerve placed on the internal surface of the choroid. It sometimes happens that, in the operation for cataract by extraction, a more or less considerable quantity of the vitreous body escapes from the eye;

* {Exterior to the retina, between it and the choroid coat, there is a fine delicate tunic which has recently been described by Mr. Jacobs of Dublin, and called after his name, the *Tunica Jacobi.*—W.}

this accident is principally to be feared on compressing the eye. It would appear, from the observations of Beer, that an eighth, or even a fourth of the vitreous humour may be lost without the vision being changed; but, then, the hyaloid membrane, as well as the iris, are carried against the opening of the cornea, become adherent to the borders of the wound, and in this way disfiguration of the pupil is produced. When half of the vitreous humour escapes, the sight becomes restored, but to a very imperfect degree; and, lastly, when two-thirds are lost, the result of the operation is still less satisfactory. Even then the iris may sometimes resume its natural form; but the pupil remains contracted round the hyaloid membrane, which projects into the anterior chamber of the eye.

§ 28. *The globe of the eye* reposes on a thick layer of fatty cellular tissue; it is surrounded by six muscles, which are destined to move it, and which contribute, at the same time, to fix it in the cavity of the orbit: these are the four straight (recti) and two oblique (obliqui). The aponeuroses of these muscles become continuous with the sclerotic on the anterior part of the eye, and have been considered, but incorrectly, as a particular membrane between the conjunctiva and sclerotic. The four *straight muscles* are fixed at the bottom of the orbit around the foramen opticum, and diverging from each other, go to the four opposite sides of the globe of the eye. The *obliquus superior* is also attached at the bottom of the orbit before and above the optic foramen; but, instead of going directly to the eye, it goes first towards the superior and internal angle of the orbit, and the tendon, by which it terminates, enters into a bit of cartilage folded on itself and fixed to the parietes of the orbit. After having passed into this kind of pulley, it again descends from before to behind, and from without inwards, to be inserted into the sclerotic between the insertions of the superior and internal straight muscles. These five muscles form a kind of cone, the base of which surrounds the eye, and the apex the optic nerve. The *obliquus inferior* is also attached to the sclerotic; but at a sufficient distance behind the tendons of the external

and superior straight muscles, and then goes from above downwards, and from without, to the inner side, towards the internal extremity of the inferior edge of the orbit.

In the centre of this muscular sheath we find the *optic nerve*, which enters the orbit through the foramen opticum. On the outer and lower side of this nerve, the *ophthalmic artery* is situated, which also enters through the same opening with it; it soon mounts on the upper side of this nerve, passes beneath the right superior straight muscle, and reaches the internal part of the orbit. Thence, it goes towards the great angle of the eye, where it divides, to form the frontal and nasal arteries. During this course it furnishes numerous branches, which are distributed to the different parts contained in the orbit, but which present nothing of interest in a surgical point of view. In fact, in the extirpation of the globe of the eye, it is very rare that pressure made by some pledgets of lint is not sufficient to stop hæmorrhage; moreover, if the ophthalmic artery were dilated, recourse must then be had not to ligature but the actual cautery, in order to suppress the flow of blood.

We also see in this part the *ciliary*, *motores oculorum*, *and ophthalmic nerves*, and numerous veins which unite to form the *ophthalmic trunk*, that leaves the orbit by the lower part of the supra-orbitar fissure to empty itself into the cavernous sinus. Lastly, at the upper part of the orbit, and immediately under the roof of this cavity, the *levator palpebræ superioris* is situated. It is attached to the bottom of the orbit close to the foramen opticum, and proceeds forwards on the upper surface of the rectus superior to the edge of the orbit, where it forms the constituent part of the lid.

All these parts are surrounded by a thick layer of fatty cellular tissue. This is also the case with the lacrymal gland, which occupies the upper and external angle of the orbit; it is, in general, formed by two distinct portions, an upper, and a lower one. The first is triangular, and is lodged in a small depression situated behind the external orbitar process; the second extends from the lower part of the former to the cartilage of

the upper lid. This gland gives origin to five or six small excretory canals, which open on the internal surface of the upper lid near the outer angle of the eye. When, in cases of cancer of the eye, extirpation of this organ is performed, the lacrymal gland is not in general comprised in the first incision, on account of its situation behind the orbitar process; but the operator should not fail to return and extirpate it, as well as all the portions of fat and cellular tissue, which are situated on the parietes of the orbit; and the consistence of which appears altered.

§ 29. Lastly, the *orbit* itself has the form of a pyramid, the axis of which is directed outwards, and the apex backwards and inwards. We may observe here four triangular surfaces: the superior, or roof, is concave, and formed by the frontal bone and small ala of the sphenoid; here we observe, on its posterior part, the foramen opticum, which gives passage to the optic nerve, and at its anterior and external part the depression which lodges the lacrymal gland; lastly, the levator palpebræ superioris lies close beneath it. The thinness of this part of the frontal bone renders it subject to fractures, and prevents us from applying at this place the actual cautery, as on the other parts of the orbit, when the periosteum covering it partakes in the cancerous affection, for which the extirpation of the globe of the eye has been performed.

The *external wall* is smooth, and formed, anteriorly, by the malar bone, and in its posterior three-fourths by the sphenoid. At the point of junction of this surface with the roof of the orbit, we perceive anteriorly the spheno-frontal suture, and posteriorly the orbitar fissure,* which gives passage to the third, fourth, and sixth pairs of nerves, and to the ophthalmic nerve and vein. The *inferior wall* is almost plane, and directed obliquely outwards: it is formed, anteriorly, by the malar and superior maxillary bones, and quite behind by the palatine. At its posterior part, the *infra-orbitar* canal commences: this is continued along the under part of the orbit, and terminates at the foramen infra-

* *Foramen Lacerum anterius.*

orbitarium, just below the anterior edge of the orbit: it lodges, as we have before said, the infra-orbitar vessels and nerves. This wall, which also forms the roof of the maxillary sinus, is very thin; and when fungous tumours, situated in this sinus, become very large, it is sometimes raised so as to push the eye from the orbit. Posteriorly, we find, between the external and inferior parietes, the spheno-maxillary fissure, which is traversed by the infra-orbitar vessels and nerves; lastly, the *internal wall*, which is the narrowest, is also the thinnest. It is formed, posteriorly, by the sphenoid; in the middle, by that portion of the ethmoid which is called the *os planum;* and anteriorly, by the os lacrymale. We perceive, at its superior part, the internal orbitar foramina, by means of which the ethmoidal branches of the ophthalmic nerve and artery penetrate into the olfactory cells. In some rare cases, exostoses of the os planum, or the internal orbitar process of the frontal, take place, and cause exophthalmia. This disease is also sometimes occasioned by a fungous tumour of the dura mater, which breaks down the parietes of the orbit, and pushes out the eye; but it generally depends on the scirrhous enlargement of the cellular tissue, which occupies the bottom of this cavity.

On account of the pyramidal form of the orbit, and the thinness of its superior and internal parietes, we should run a great risk of fracturing them, if, in extirpating the globe, we employed the instrument recommended by Bartisch.* By the method generally adopted at this time, this accident is much less to be feared; but, however, we must take great care to avoid piercing with the point of the knife these thin and delicate bones, or to introduce it into the openings which we have described as situated at the bottom of the orbit.

The *circumference of the orbit* does not present any thing remarkable, excepting at its internal part, where we find the lacrymal duct, the anterior half of which is

† {Bartisch employed a concave instrument with cutting edges; it was introduced beneath the upper eyelid, and the eye then scooped from the orbit. The best instrument for the purpose, we conceive to be the straight-bladed bistoury.—W.}

formed by the os lacrymale, and which is continuous inferiorly with the nasal canal.

§ 30. We have already examined the soft parts which cover the nose: there only remains now, in order to finish the description of the naso-orbitar region, to speak of the frame-work of this organ, and of the nasal fossæ, which are situated below.

The ground, or frame-work of the nose, is formed superiorly by the ossa nasi, and by the nasal processes of the superior maxillary, and inferiorly by cartilage. The *ossa nasi* are thick superiorly, where they are articulated with the frontal, and thin inferiorly, where the cartilages are attached. At this part they present a small slope, which gives passage to the ethmoidal filaments of the nasal branch of the ophthalmic nerve, which proceed from the nasal fossæ, in order to ramify under the skin. The *nasal process of the superior maxillary bone* is articulated with the external border of the os nasi, with the frontal and os lacrymale, and thus contributes to form the anterior wall of the nose: it is rather thick, and on its inner surface we find the lacrymal duct and nasal canal, which is only a continuation of the former.

The projection formed by the nose, and the thinness of the soft parts which cover it, render fractures of this bone very frequent, after cuts or blows on this part. In general, these accidents are only serious when they are accompanied with concussion of the brain; but sometimes they give rise to incurable fistulæ lacrymales. When the fragments are displaced, it is easy to restore them to their natural situation, by pushing them to the outer side, with the assistance of an instrument introduced into the nostrils.

The inferior part of the nose is formed of cartilages and a fibro-cartilaginous structure. In the median line we find the *cartilage of the septum*, of which we shall speak more in detail when we describe the nasal fossæ. The lateral cartilages are of a triangular figure, and intimately united to each other, and to the upper edge of the cartilage of the septum: superiorly they are fixed to the ossa nasi, and posteriorly to the nasal process; inferiorly they are united, by very thick cellular tissue,

to the *fibro-cartilaginous structure of the alæ of the nose.* This is attached to the maxillary bone by its posterior extremity: it proceeds forwards towards the tip of the nose, and then folds on itself, resting on that of the opposite side: it returns to the posterior part of the nasal septum, so as to surround the nares. Sometimes this fibro-cartilaginous structure is divided into several distinct pieces. The nares, or anterior orifices of the nasal fossæ, are oval openings, directed downwards, and always remaining open, from the situation of the cartilage which surrounds them.

§ 31. The *nasal fossæ* are two large cavities, situated below the base of the cranium, above the mouth, before the pharynx, behind the nose, and between the orbits and zygomatic fossæ. They are separated from each other by a vertical septum situated in the median line, and lined by a mucous membrane called the *pituitary membrane*, or *membrane of Schneider*, and which secretes the nasal mucus: it incloses a great number of mucous follicles, and in its whole extent, except at the inferior and anterior part of the nose, it is covered by very short villi, which have given it the name of villous membrane. The arteries which ramify on it are very numerous and very superficial, as are also the veins, an arrangement which explains the frequency of nasal hæmorrhages without rupture. Some anatomists regard this membrane as being formed by two distinct layers; but the internal, the structure of which is fibrous, and which closely adheres to the external, is nothing else than the periosteum belonging to the bones which form the parietes of the nasal fossæ.

§ 32. The *superior wall, or roof of the nasal fossæ*, presents three very distinct parts—an anterior, a middle, and a posterior. The anterior portion is inclined obliquely from above downwards, and from behind forwards: it is formed by the triangular cartilage and ossa nasi, on the surface of which we find a vertical sulcus, which lodges the ethmoidal nerve, and one or two small openings, which give exit to vessels and nerves. The middle or superior portion is much straighter than the preceding, and is directed horizontally from before to behind. It is formed by the cribriform plate of the eth-

moid. This bone, very thin and brittle, presents very numerous small openings, which give passage to the olfactory nerve and ethmoidal branches of the ophthalmic: these arteries, two in number, arise in the orbit, penetrate into the ethmoidal cells by the foramina orbitaria interna, and then pass into the interior of the cranium, one by a small canal deepened in the ethmoid, the other by a small fossa, which we find at the anterior part of the cribriform plate, and which gives passage also to the ethmoidal nerve. Lastly, they divide into small branches, and traverse the orifices of this osseous plate, in order to be distributed to the pituitary membrane. The posterior portion is short and broad, and descends almost vertically: it is formed by the body of the sphenoid, the cornua of Bertin, the palatine and posterior border of the vomer. We find, a little above its middle part, an opening, the form and dimensions of which differ very much, but which, generally, looks directly forwards, or a little inwards: it is the opening of the *sphenoidal cells*, cavities situated in the body of the os sphenoideum, and which extend generally much below the level of this opening.

The portion of pituitary membrane which lines the roof of the nasal fossæ, presents very marked differences. Around the nares it is thinner, and less coloured than in the other parts: it is here confounded with the integuments of the nose and upper lip, and covered with a considerable number of hairs. A little higher up we find a distribution of some vessels coming from the dorsal artery of the nose, and some small veins, which traverse the cartilages of the nose, and terminate in the angular vein. On the cribriform plate, the pituitary membrane is thicker and softer: it closes all the foramina with which this bone is pierced, and the nerves and vessels which traverse them terminate in its substance. On the posterior portion of the roof, this membrane presents numerous follicles, and a compact tissue; this dips into the sphenoidal sinus, lines its parietes, and forms, at its orifice, a fold which contracts this opening to a greater, or less extent. We observe, in this part, veins traversing the sphenoidal sinuses, and which, according to Vicq d'Azir, commu-

nicate with the cavernous sinus: this may explain, in some degree, the critical hæmorrhages which take place in certain affections of the head. Lastly, as polypi may develope themselves on every part of the pituitary membrane, it is in this part, near the posterior nares, where, according to Bell, they most frequently form.

§ 33. The *internal wall of the nasal fossæ* is vertical and smooth: it is formed by the septum which separates the two cavities of this name, and is generally found on the median line; sometimes it is more or less thrown to one side. The perpendicular plate of the ethmoidal bone above, the vomer behind, and the cartilage of the septum before, compose this part of the parietes: it extends from the nasal spine of the frontal, to the eminence of the same name situated on the superior maxillary bone, and to the body of the sphenoidal. The pituitary membrane, which covers it, incloses several small yellowish glands: it is very thick and vascular. The superior labial artery terminates on its inferior part. Lastly, according to M. Boyer, it is generally at the middle part of this septum that the benign ulcers are situated with which this membrane is sometimes affected.

§ 34. The *inferior wall of the nasal fossæ* possesses the form of a large groove, which extends directly from before to behind, for about two inches. Its anterior part is situated a little above the level of the inferior border of the nares, and ascends a few lines; but it soon follows a contrary direction, and is slightly inclined towards the pharynx, an arrangement which very much favours the discharge of the nasal mucus. This wall is formed by the superior maxillary bone before, and the palatine behind: it separates the nasal fossa from the cavity of the mouth, the roof of which it also forms. The pituitary membrane does not present any thing remarkable, excepting in front, where it receives some vessels which arise from the palatine artery, and traverse the anterior palatine canal, the superior maxillary bone being deepened in this spot. It is principally in this part that the nasal fossa is the broadest: it is also here that instruments must be introduced, either

for operating in these cavities, or for carrying them into the pharynx.

§ 35. The *external wall*, which is formed by the superior maxillary, the ethmoid and inferior spongy bones, is inclined obliquely from above downwards, and from within outwards, so that the space which separates it from the internal wall diminishes from the inferior to the superior part of the nasal fossa. At its lower portion we observe the meatus inferior, a groove concave from above to below, and straight from before to behind, which extends transversely between the floor of these fossæ and the *os spongiosum inferius*. The eminence which bears this name is of a very variable form: generally it is a thin plate, curved on itself, and the free border of which is turned downwards: its superior surface is convex from above to below—the inferior concave in the same direction. Its anterior extremity is curved a little downwards, and more elevated than the posterior, which terminates in a point. The pituitary membrane slightly adheres to this bone, and forms, on its free border, a fold which enlarges, and extends farther backwards than the bone does by descending towards the pharynx. This fold is often the seat of indurated swellings.

Below the anterior part of the os spongiosum inferius, and under the meatus inferior, we find *the lower orifice of the nasal canal*. This opening is generally elliptical, oblique in its direction, and about six lines distant from the beginning of the nares: it is concealed under the os spongiosum inferius, and turned a little backwards: its breadth varies considerably. The nasal canal proceeds obliquely upwards, forwards, and a little outward, towards the great angle of the eye. It is sometimes situated entirely in an excavation of the superior maxillary; but, generally, the os spongiosum inferius and os unguis equally contribute to its formation. The membrane which lines it is a continuation of the pituitary; and it sometimes forms a soft and pendent fold of a greater or less length, which is situated against the external wall of the canal. It is by this opening that, according to Laforest, sounds are introduced into the nasal canal, to re-establish the flow of tears in the

case of fistula lacrymalis. In order to reach this place, the sound must glide on the floor of the nasal fossa, under the inferior spongy bone, by turning the convex side of the instrument towards the septum, to the place where we feel that its point has passed beyond the ascending branch of the superior maxillary. Then the sound is turned between the fingers, in order to direct the point above and within the side of the eye, taking care to make it glide, during this movement, on the wall of the lower meatus. The handle of the instrument is thus depressed by this rotatory motion, its point being placed in the nasal canal, and then made gently to advance towards the lacrymal sac. This operation, generally easy to perform on the dead, is very difficult on the living, subject, not only on account of insupportable tickling which it occasions, but also numerous variations which are met with in the anatomical disposition of these parts. Indeed, this opening is sometimes so narrow, that it admits with difficulty a very small probe; or the pituitary membrane which lines the nasal canal extends beyond it, and forms a kind of curtain round this opening. In some cases, the partition of the nasal fossæ is inclined so as to press against the lower spongy bone; in others, this eminence is placed so low, that the probe passes on its superior surface, whatever may be the effort made to cause it to glide beneath; or rather its free edge is prolonged, so as to transform the lower meatus into a kind of canal. For these reasons the operation has been abandoned: moreover, inflammation of the pituitary membrane, and fracture of the lower spongy bone have sometimes occurred from the attempts to perform the operation.

At a certain distance above the inferior spongy bone, we observe another transverse projection, almost parallel to the first, but not quite so long: it is the *middle*, or *ethmoidal spongy bone*. It is convex externally, concave internally, thin above, and thick below and before: its free border is turned downwards, and is furnished with a fold of pituitary membrane, which terminates in a point posteriorly. The space situated between these two bony parts is not so deep before as behind, and constitutes the middle *meatus*. It is in this part of the

nasal fossa that we make an opening, in order to perforate the os lacrymale, and to make an artificial course for the passage of the tears, from the lacrymal sac, into this cavity.

Hunter tried to perform this operation by the aid of a sharp-edged tube and a piece of horn, which he introduced into the nostrils to serve as a point of support; but the space comprised between the anterior extremity of the lower spongy bone and the os unguis which is to be perforated, is in general so narrow that it would be difficult to introduce the horn into it so that it should offer a sufficient support to the tube. The result of this would be, that the instrument would perforate the os unguis and the pituitary membrane, without causing any real loss of substance.

Under the anterior extremity of the middle os spongiosum, a narrow passage is situated which leads to the orifice of the anterior ethmoidal cells. One of these cells placed before the others forms a kind of tortuous canal, which opens superiorly into the frontal sinuses, and is called *infundibulum;* its inferior extremity is expanded, and corresponds to the opening which leads into the nasal fossæ. The pituitary membrane enters it without forming any fold, and lines the ethmoidal cells and frontal sinuses. Towards the point of union of the two anterior and posterior thirds of the middle meatus, and behind the middle spongy bone, a second irregular and narrow opening is situated, which leads into the *maxillary sinus*, or *antrum of Hyghmor.* This cavity is situated in the body of the superior maxillary bone; it is very large, and of a pyramidal form with four surfaces, the apex being directed towards the cheek, and the base to the nasal fossæ. The superior wall of this sinus constitutes the floor of the orbit; it is thin and inclined forwards, and intercepted by the infra-orbitar canal. The anterior wall corresponds to the canine fossa, presenting an opening, which is a continuation of the infra-orbitar canal, which lodges the superior dental nerves and arteries. This, being the thinnest part, is the one which generally yields the first to the accumulation of liquid constituting dropsy of the maxillary sinus. Sometimes, on the contrary,

in cases of this nature, all the walls of this cavity are separated from their axes and acquire an enormous size. The same effect may also be produced by the development of polypi in the sinus. The posterior wall corresponds to the zygomatic fossa; the inferior to the alveolar arch: it is very narrow, and often pierced by the root of the canine tooth, as will be seen when we describe the buccal region. The inner wall is formed by the ethmoidal, superior maxillary, palatine, inferior spongy, and sometimes lacrymal bones. It presents the opening by which the cavity communicates with the *middle meatus;* this orifice is raised above the bottom of the cavity, and is bounded by a fold of the pituitary membrane, which incloses in its substance a kind of gland which forms a sort of narrow membranous canal, directed obliquely from before to behind. The portion of the pituitary membrane which lines this membrane, as well as that which covers the other olfactory sinuses, does not present the same characters as that which covers the parietes of the nasal fossæ. In general it is very thin, smooth, of a pale colour, entirely deprived of follicles, and strongly adhering to the bones. The great number of twigs which the superior dental nerves send to this membrane as it descends along the parietes of the sinus, is the reason why it is inflamed so often in cases of dental discharges. When the secretion from the sinus is greater than the absorption which takes place, an accumulation of mucus results, and sometimes the formation of a fistulous opening, either at the cheek or the alveolar processes; for the natural orifice of this cavity, being situated above the level of the base of this cavity, can only serve for the discharge of the liquid: it often happens that it is obliterated in consequence of inflammation, with which it is affected. In cases of this kind, it has been proposed to throw an injection into the sinus by means of a curved tube introduced into it from the nostrils. But, as M. Boyer has justly observed, reason and experience demonstrate the insufficiency of this means, and its use was soon abandoned. When there is an abscess of the sinus, an artificial opening must be made to give passage to the purulent matter, and the

spot chosen for making it is the alveolar arch, at the insertion of the second molar tooth.

Above the middle spongy bone, a third transverse passage is situated, smaller than the two others, and called the *superior meatus;* it is bounded above by the *superior spongy bone*, a very thin layer of the ethmoid directed downwards and backwards, and curved on itself, being concave in its inferior surface, and terminated anteriorly in a kind of cul de sac. Behind the upper meatus it is continuous with the vertical fissure, which ascends with a slight degree of obliquity by the sides of the ethmoid and body of the sphenoid bone. The *orifice of the posterior ethmoidal cell* is situated at the anterior and superior part of the meatus. M. Boyer believes, that the depressions at the superior part of the nasal fossæ are the seat of oezena, a disease consisting of an alteration of the pituitary membranes, and a necrosis of some part of the bone.

Lastly, at the posterior part of this meatus we find the *spheno-palatine foramen*, which is directed from within to without, and corresponds to the spheno-maxillary fissure. It is covered by the pituitary membrane, and gives passage to the spheno-palatine artery and veins, and to some nerves from the ganglion of Meckel, which ramify in the parietes of the nasal fossæ. In the rest of its extent, the external wall presents nothing remarkable. The bones which form it are very thin, and very brittle in the middle part, but much thicker and stronger at their anterior and posterior edges. Lastly the pituitary membrane is softer and thicker on the spongy bones than at any other part.

The *posterior opening of the nasal fossæ* is nearly square, and formed of the four parietes of which we have been speaking; it is nearly an inch high, and half an inch broad: we shall have occasion to return to it when speaking of the pharynx.

CHAPTER III.

ANTERIOR AND INFERIOR REGION OF THE HEAD, OR MAXILLARY REGION.

§ 37. The space comprised between the median line of the face and anterior border of the masseter, from before to behind, and the naso-orbitar region and inferior border of the lower jaw, from above downwards, constitutes the inferior region of the face, or maxillary region. Anteriorly, we observe a small groove, which, situated on the median line, extends from the septum of the nose to the upper lip; lower down we find the mouth, the lips, and chin; a little beyond the commissure of the lips, a furrow of an arched shape is situated, which extends downwards and backwards from the ala of the nose. Still farther, on the cheek, is the canine fossa; and lastly, the zygoma, a projection situated at the superior and posterior parts of this region.

The skin which covers this part of the face is very thin, especially on the cheeks; about the mouth and on the lower jaw, it serves, in man, for the insertion of the hairs of the beard, and incloses a great number of sebaceous follicles. On the zygoma, the integuments are only separated from the bones by a thin layer of firm cellular tissue, in the substance of which the malar branches of the lacrymal nerve and artery, and facial nerve, ramify. In the canine fossa, the sub-cutaneous cellular tissue is abundant, loose, and incloses a great quantity of fat. At the posterior and inferior part of this region, before the masseter, we find under the skin a still thicker layer of fat and cellular membrane. Lastly, on the lips and chin the skin closely adheres to muscular fibres, and we only find below it a few fine short layers of cellular membrane, and these nearly deprived of fat. The differences just alluded to determine the character of the inflammation which occurs in these various parts. In fact, on the cheek it is generally rather erysipelatous than phlegmonous; whilst, in the other parts of the face, it is accompanied by much

swelling, and terminates often in abscesses. It, therefore, results, that in the operations which we perform on the cheek, as much care as possible must be taken of the integuments and sub-cutaneous cellular tissue; but in other parts wounds with great loss of substance may be inflicted, without the cicatrization which is formed being very large.

§ 38. The muscles which are connected with the integuments around the mouth, are the orbicularis oris, and the terminations of the levator labii superioris alæque nasi and levator labii superioris, of the zygomaticus major and minor, of the levator anguli oris, depressor anguli oris, depressor labii inferioris, and levator labii inferioris. The *orbicularis oris* is a thin, broad, and flattened muscle, and formed by concentric fibres which surround the mouth, and are continuous externally with the other muscles of this part; anteriorly, it is intimately connected to the skin. The *levator labii superioris*, also thin and flattened, is continuous with the former, between the ala of the nose and angle of the mouth; superiorly, it is inserted into the os malæ and superior maxillary bone just below the orbicularis palpebrarum (vide § 19.) The *levator labii superioris alæque nasi* is situated anterior to the former. The *zygomaticus major*, thin and elongated, extends obliquely from the os malæ to the commissure of the lips, where it meets the fibres of the orbicularis oris and depressor anguli oris, &c. At its anterior surface it is covered superiorly by the orbicularis palpebrarum, and more inferiorly by fatty cellular tissue, which separates it from the skin. The *zygomaticus minor* is often wanting; when it does exist, it is situated internal to, and below the preceding, and is inserted into the same parts. The *levator anguli oris* proceeds obliquely from the centre of the canine fossa, towards the commissure of the lips, where it appears to be continuous with the depressor anguli oris (vide § 19.) Its anterior surface is covered superiorly by the infra-orbitar vessels and nerves, and by a great quantity of fatty cellular tissue, which separates it from the levator labii superioris; inferiorly, it is connected with the zygomaticus minor and the skin. The *levator labii inferioris*, situated on

the median line, is inserted into a small fossa, which is found on the side of the symphysis of the chin, and is then lost in the skin. The *depressor labii inferioris*, situated on the outer side of the preceding, is attached to the external oblique line of the inferior maxillary bone, and is lost in the substance of the lip; anteriorly, it is covered by the *depressor anguli oris*. This last muscle is fixed to the lower border of the inferior maxillary bone, from the masseter to the foramen mentale, and its fibres ascend by converging towards the commissure of the lips; anteriorly it firmly adheres to the integuments in its whole extent. Lastly, its lower border is covered by a few fibres of the platysma myoides.

A great number of nervous filaments ramify and anastomose on the surface, or in the substance of the muscles: they come principally from the seventh pair, and go from behind to before; but they do not present any thing remarkable.

§ 39. At the posterior and inferior angle of this region, we observe, under the depressor anguli oris, and platysma myoides, the *facial artery*, which ascends on the inferior maxillary bone, immediately before the masseter. Its superficial situation, and the slight degree of resistance offered by the bone on which it rests in this place, renders its compression very easy, and we can, by this means, stop the flowing of blood, in almost all the operations which are performed on the face. This vessel takes an oblique course from above forwards, towards the side of the nose, and gives origin to a great number of branches. A little below the level of the angle of the mouth, it furnishes the *inferior coronary artery*, which proceeds in a serpentine direction into the substance of the lower lip, and approaches its free border towards the median line; it anastomoses with that of the opposite side, after having sent numerous branches to the muscles and integuments. Towards the free edge of the upper lip, the facial artery passes under the fibres of the levator anguli oris, and then ascends on the side of the nose; a little above the commissure, it gives origin to the *superior coronary artery*, which is rather large and tortuous; it goes horizontally from behind forwards into the free border of the upper

lip; lastly, on the median line one of its branches anastomoses with the artery of the same name of the opposite side, and another ascends vertically towards the septum of the nose. During this course, this vessel as well as the inferior coronary, gives origin to a great number of branches which form an anastomatic network around the mouth; it is situated at the posterior surface of the orbicularis, and is only separated from the mucous membrane which lines the lips by a few glands. In the operation for hare-lip it is essential to mind this anatomical arrangement, for, as Burns observes, the needles with which the edges of the wound are pierced, ought to be sufficient for stopping the flow of blood from the divided extremities of the coronary arteries, although their principal use be to keep these parts accurately in apposition; and in order to effect these objects, the needle must be made to penetrate with great care behind the place where the artery is situated, and near the free border of the lip. If the needle be introduced before these vessels, the posterior part of the wound would remain open, and hæmorrhage continue for a long time without our being aware of it. If the needle be placed too far from the free border of the lip, the same untoward circumstance would then occur.

§ 40. The *facial vein*, which we have already followed up to the place where it passes beneath the zygomaticus major, continues its course under the posterior inferior angle of this region in nearly the same direction as the facial artery. It is situated much nearer the masseter than the artery, except on the border of the inferior maxillary bone. Lastly, the coronary and buccal veins open into it.

§ 41. At the posterior superior part of the triangular space which exists between the masseter, zygomaticus major and depressor anguli oris, and which is filled by fatty cellular tissue, we find the excretory duct of the parotid gland, or the *duct of Sténon*. After having proceeded between the masseter and teguments, it bends on the anterior border of this muscle at the distance of three to five lines from the zygomatic arch, and then proceeds forwards, downwards, and a little inwards,

towards the anterior part of the buccinator, passing under the zygomaticus major and facial vein. This duct is of a whitish colour, a little flattened, and about a line in diameter; sometimes opposite the edge of the masseter, at other times farther back, it receives one or two small canals which proceed from the accessory parotid—a glandular body, small, and varying in form; it is in general situated on the upper edge of the true parotid. Arrived at the external surface of the buccinator, the duct of Sténon traverses this muscle (as we shall soon see) at about four or five lines from the anterior edge of the masseter. In nine subjects out of ten, the course of this canal corresponds, according to Burns, to a straight line, drawn from the anti-tragus to a spot between the nares and angle of the mouth. The surgeon ought to bear all these details accurately in mind; for, in almost all the operations performed on the cheek, we must carefully avoid wounding this duct; an accident which would be followed by the formation of a salivary fistula: and at other times we are obliged to establish an artificial communication between its cavity and that of the mouth, to re-establish the course of the saliva, and to effect the cure of the disease of which we are speaking. The salivary fistulæ may be situated in any part of the Stenonian duct; but it is only when they exist in the portion which we are now describing, that this operation can be useful. In fact, in order that the artificial communication which is established between this canal and the mouth, may prevent the saliva from trickling by the fistulous opening, it must be situated nearer the parotid than the latter orifice; and the anatomical arrangement of the parts placed between the Stenonian duct and the mucous membrane which lines the mouth, does not allow the opening of which we are now speaking to be made, except at the anterior edge of the masseter.

Several *branches of the seventh pair* accompany the Stenonian duct, and terminate in the cheek. One of these, larger than the rest, passes between this canal and the zygomatic arch. The *transverse artery of the face* arises from the external carotid or temporal in the parotid gland, and proceeds from behind forwards on

the masseter, above the parotid duct; divides, towards the anterior border of this muscle, into several branches, which are distributed to the muscles and integuments of the cheek, and which form numerous anastomoses with the branches of the facial, buccal, and infraorbitar arteries.

The Stenonian duct rests on a mass of fatty cellular tissue, which forms a kind of bundle almost isolated from the neighbouring parts, extending backwards between the masseter and buccinator, and inclosing some lymphatic glands. When the tumours formed by accidental tissues are developed in this place, we must, if possible, extirpate them before they adhere to the adjoining parts, to avoid injuring the parotid duct during the operation. When these tumours are situated before this canal, it is in general rather easy to extirpate them without opening it, provided the precaution be taken of exposing it from the side of the parotid before the operator commences detaching the morbid mass; but this operation is much more difficult when we find the tumour lodged behind the parotid duct: if it be of a firm and resisting texture, it then pushes the duct forwards, or to one side; but if it be flexible, and of a soft consistence, it may surround it entirely, or in part, without being displaced. Indeed, this vessel, together with the facial vein, has been often found lodged in the substance of steatomatous tumours, fungus hematodes, and aneurisms by anastomosis.

§ 42. The *buccinator*, which is situated under the cellular fatty layer of which we have just spoken, is thin, flattened, and of a quadrilateral form. Its fleshy fibres are inserted into the posterior part of the alveolar border of the two jaws, and the internal ala of the pterygoid process, by the medium of an aponeurotic prolongation; they converge towards the commissure of the lips, where they are continuous with those of the orbicularis. The external surface of this muscle is intimately united to a kind of whitish membrane formed by condensed cellular tissue. Internally, it is in contact with the mucous membrane which lines the mouth. Anteriorly, the buccinator is traversed by the parotid duct, which, after becoming contracted, opens

at the internal part of the cheek very near the second or third molar tooth of the upper jaw, about three lines from the angle which the mucous membrane forms where it folds on the gums. It traverses this muscle directly from without inwards, and then turns obliquely forwards along the mucous membrane. It is of importance to remember this anatomical arrangement when it becomes necessary to introduce a probe into this canal; for the angle which the duct makes at the place where it traverses the buccinator muscle, might stop the point of the instrument, if great care were not taken to change its direction, by raising the cheek on the sides of the extremity of the probe with the assistance of the fore and middle fingers introduced into the mouth. The looseness of the parietes of this canal might also occasion an obstacle to the introduction of the probe, by allowing the membrane which lines it to fold on itself.

§ 43. The mucous membrane which covers the internal surface of the buccinator is continued anteriorly for the purpose of lining the internal surface of the lips, where it is only separated from the orbicularis and coronary vessels by labial glands; it is very red, fine, thin, and covered by a distinct epidermis. The abscesses which form in the lip open spontaneously on this side; and moreover, if it were necessary to open them by the assistance of a sharp instrument, it should be done on the mucous membrane, not only to avoid the deformity which would result from a cicatrix externally, but also because this membrane is much less sensitive than the skin. The labial glands consist of rounded mucous follicles, which open separately on the internal surface of the lips by excretory ducts. A little beyond the alveolar arch the mucous membrane is reflected, in order to cover the gums. In the remainder of the extent of this region the muscular layer is found in contact with the bones of the face, excepting below the nose and near the chin. In the first of these points a small bundle, which is fixed to the superior maxillary bone, near the nasal spine, and to the ala of the nose, and which is called the *depressor alæ nasi*, is placed behind the inferior extremity of the levator labii supe-

rioris alæque nasi. On the side of the chin we find, under the depressor labii superioris, the *inferior dental vessels and nerves*, which pass from the dental canal by the foramen-mentale, situated below the first or second small molar tooth.

§ 44. The bones of this part of the face consist of the malar, and the two maxillary. The os malæ and malar process of the superior maxillary bone form a very considerable eminence at the posterior superior angle of this region. An obtuse projecting border, descends vertically from this process, and bounds posteriorly a shallow fossa, which is called the *canine*. It gives attachment to the levator anguli oris, towards its inferior part, and presents superiorly the *infra-orbitar foramen*, which gives passage to the vessels and nerves of the same name. This opening is distant about three lines from the ridge of the orbit, and is placed above the first or second small molar tooth. By drawing a line from the first incisor tooth, to the external angle, and another from the second large molar tooth to the internal angle of the eye, we can determine, with great exactness, the situation of the infra-orbitar foramen; for, it will be found very near the point where these two lines cross each other. When, in cases of tic douloureux, we wish to divide the superior maxillary branch of the fifth pair, it is at its exit from this foramen that the operation must be performed.

Before the canine fossa, and below the nose, is a small sulcus called the *fossa myrtiformis*, in which the depressor alæ nasi is inserted. It is separated from the canine fossa by a small vertical ridge which descends between the canine and second incisor teeth, and which results from the junction of the inter-maxillary portion with the rest of the bone. When this junction does not take place before birth, there remains a *hiatus*, a deformity which is often complicated with congenital hare-lip, and which sometimes exists on the median line, in consequence of the non-union of the two inter-maxillary pieces. The external surface of the superior maxillary bone terminates inferiorly in the *alveolar arch*, which presents alternate elevations and depressions corresponding to the alveoli. The

buccinator is inserted posteriorly above this arch, which is covered by a dense, solid, reddish, and vascular tissue, that surrounds the teeth, and forms the gums. The external and inferior parietes of the maxillary sinus (vide § 35.) correspond to the canine fossa and alveolar ridge; thus it is, by perforating either of these parts, that this cavity may be opened when we wish to extract polypi, or obtain the free discharge of pus which is collected in it. In this last case, it is generally the alveolar ridge which is perforated between the first and fourth molar teeth: this being the spot which corresponds to the lowest part of the sinus. The same advantages could not be obtained by making the opening below the malar eminence; but which, however, according to Lemonnier of Montpelier, is the place to be selected for the performance of this operation. If a polypus is to be extirpated from the maxillary sinus, the opening should be made in a spot where the parietes of this cavity are the thinnest; but, unless circumstances should imperatively require it, it is better to perform the operation at the alveolar arch, or in the canine fossa, below the infra-orbitar foramen, than below the malar eminence; for, in this last case, we should be often obliged to divide the commissure of the lips in order to expose the spot to be trephined.

The lower jaw presents on the median line the *symphysis of the chin*, a vertical line formed by the union of the two portions of the inferior maxillary bone, and below which we perceive the projection called the chin. From the inferior angle of this projection, the *external oblique line* proceeds, ascending backwards towards the coronoid process, and giving attachment to the depressor anguli oris, depressor labii inferioris and platysma myoides. The levator labii inferioris is attached above to the chin. Lastly, above this line, and below the first or second small molar tooth, is situated the foramen mentale. The cellular tissue which unites the surface of the inferior maxillary bone to the integuments and soft parts of which we have spoken, is loose and slightly serrated; it is thus possible to remove a great portion of the lower lip without a large cicatrix being formed. The internal surface of the lower jaw is con-

vex, and presents a projecting ridge which passes obliquely from before to behind, and from below upwards, towards the coronoid process, and which serves for the insertion of the mylo-hyoideus (which name it bears), and also of the superior constrictor of the pharynx. At the anterior extremity of this oblique line, we observe the point of attachment of the digastricus, and by the side of the symphysis of the chin, the geni processes, eminences to which the genio-hyoidei and genio-glossi are attached. Above these spots we find a depression destined to lodge the maxillary gland, and higher up a smooth surface, which is covered by the mucous membrane of the mouth. The different muscles which we have just enumerated all serve to depress the jaw, whilst those which raise it are situated at its posterior extremity: thus, when this bone is fractured before the point where the masseter is inserted, the displacement of the fragments is very considerable, for the anterior is drawn downwards, and the posterior upwards, and fixed against the upper jaw.

§ 45. The *cavity of the mouth* is circumscribed, forwards and outwards, by the lips, the cheek, and alveolar arches; superiorly, by the hard palate; inferiorly, by the tongue and the maxillo-hyoidean layer of muscles; and posteriorly, by the soft palate and *throat*, an opening by which it communicates with the pharynx. The *roof of the mouth* is concave and semi-oval. The mucous membrane which lines it is thick, of a pale colour, and presents a great number of transverse rugæ. In the centre, we observe a whitish line extending from before backwards, and terminating anteriorly in a small tuberosity which is situated behind the incisor teeth, and corresponds to the opening of the anterior palatine canal. In addition, this membrane is interspersed with several small foramina—orifices of the sub-mucous follicles, the number of which is very considerable, particularly behind. Lastly, it is closely connected to the bones which form the palate, through the medium of a fibro-cellular layer, consisting of a tissue analogous to that of the gums with which it is continuous. The roof is formed by the inferior surface of the palatine processes of the superior maxillary bone, and horizon-

tal branches of the palatine. These bones, at their union on the median line, form a longitudinal suture, which extends from the incisor teeth to the posterior nasal spine. At the fore part of this suture the inferior orifice of the *anterior palatine canal* is situated, which gives passage to the naso-palatine filaments; these nerves proceed from the ganglion, which is lodged in this bony canal, and are distributed to the mucous membrane, behind the incisor teeth. Towards the point of union of the posterior third, with the two anterior thirds of this arch, we observe a second transverse suture, traversing the first at right angles; it is the palato-maxillary suture. Externally, we find the opening of the *posterior palatine canal*, which gives passage to the nerve and vessels of the same name.

The palatine arch separates the mouth from the nasal fossæ; these two cavities communicate also, when this septum is destroyed, to a greater or less degree, in consequence of caries, or any other cause, as for instance, the non-development of the bones. This condition exercises a great influence on the tone of the voice; and, in order to remedy it, the septum may be re-established by the aid of a metallic obturator*.

§ 47. Posteriorly, the palatine arch is continuous with the *velum pendulum palati*, a membranous septum, which descends obliquely from above downwards, and

* An excellent obturator, for this purpose, has been invented by Mr. Weiss of the Strand, and is recommended by Sir Astley Cooper in his lectures. The instrument consists of two silver plates attached to each other by a small neck. The upper plate is less than the under, and is divided into two equal parts. The plates and neck are pierced by a square aperture, for the reception of a key. When the instrument is about to be introduced into the opening of the palate, one part of the top plate is to be turned upon the other by means of the key. It then, of course, forms only half a circle, and, by giving it an oblique direction, will pass through a very small aperture. After it has been so introduced, by giving the key another half turn, the divided plate again forms a complete circle, and thus effects the closure of the hole. The neck of the instrument must, of course, be proportioned to the thickness of the palate. Each plate should be in contact with the parts above and below, without pressing heavily in any particular situation, lest it should produce ulceration.—*Vide Lancet*, vol. iii. p. 325.—T.

from before backwards towards the base of the tongue. The lips, the roof of the palate, and the velum pendulum, may be the seat of congenital fissure of greater or less length. M. Roux* has shown, that, by the aid of an operation which he calls staphyloraphy, and which is analogous to that of hare-lip, this defect in formation may be cured.† The mucous membrane, which covers the velum, is a prolongation of the palatine membrane, and, after having lined the posterior surface of this septum, it is continuous with the pituitary membrane. The cellular layer, placed immediately beneath, is thin, dense, and serrated; it contains a great number of mucous glands and ramifications of vessels, and covers the muscles of the palate, which are destined to relax or stretch this moveable septum. The first are, the *palato-pharyngeus*, a thin and long bundle of fibres, which arises on the side of the pharynx, proceeds upwards and inwards, divides into two layers between which the levator palati mollis is placed and is continuous with its fellow, on the median line of the velum: then the *glosso-pharyngeus*, the lower extremity of which is lost in the base of the tongue, the upper being continuous with the palato-pharyngeus, and circumflexus palati. The

* If the author intends to imply, in this passage, that M. Roux first pointed out the operation of staphyloraphy, he is certainly incorrect. M. Roux first performed the operation in France, but P. Graefe, of Berlin, had performed the operation successfully nearly three years prior to that time. The earliest mention of this operation is contained in Hufeland's Journal for January, 1817, p. 116, among the notices of the Medico-Chirurgical Society of Berlin:—"Sitting of December 27.—P. Graefe spoke of the congenital division of the soft palate, as well as that produced by disease. This surgeon had made several unsuccessful attempts to cure the complaint, till, at last, in one case, where the separation was very considerable and had extended to the hard palate, the idea struck him that union might be effected by means of ligatures and inflammation artificially produced. He then invented, for this purpose, some needles and an instrument, by means of which they might be applied. With these, in conjunction with the acidum muriaticum and tinctura cantharidum, a complete cure was produced, so that the person could afterwards swallow without inconvenience, and speak quite plain."—T.

† {This operation has been successfully performed in this country by Professor Stevens of New-York.—W.}

second are, 1st, The *azygus uvulæ*, which descends vertically from the posterior nasal process, into the substance of the uvula. 2nd, The *levator palati mollis*, which is attached to the anterior border of the petrous portion of the temporal bone, and to the Eustachian tube, proceeding forwards and downwards, and becoming continuous with that of the opposite side, by forming an arch between the two layers of the palato-pharyngeus. 3rd, and lastly, the *circumflexus palati*; this muscle arising from the superior extremity of the pterygoid process, goes downwards, and inwards, and terminates in a flattened tendon, which is reflected on the hamular process, and at the superior part of the velum palati. The inferior border of this septum is free and floating; on the median line, it presents a conical prolongation, which is called *uvula*, and which is formed by the azygus uvulæ, and by a number of very large subcutaneous mucous follicles, especially towards its inferior extremity. This appendage very easily swells, and may be lengthened so as to reach the entrance of the larynx; when this state becomes chronic, the common name of prolapsus or relaxation of the uvula is given to it, and the irritation produced by the extremity of this prolongation on the base of the tongue, or on the larynx, sometimes renders its removal necessary. A larger or smaller portion of the uvula can be removed, without any difficulty or unpleasant result.

§ 48. The extremity of the inferior border of the roof of the mouth is, in some degree, bifurcated, and is continuous on the lateral parts of the throat with the vertical eminences which are called the *pillars of the fauces*, and which are generally about two on each side of the mouth. The anterior pillar, formed by the constrictor isthmi faucium, and covered by the mucous membrane, is thinner than the posterior, and is continuous inferiorly with the side of the base of the tongue. The posterior pillar is formed in the same manner, by the palato-pharyngeus, and is lost in the sides of the pharynx. In their descent. these two pillars separate from each other, and leave between them a triangular space, in which are lodged the *amygdalæ*, or *tonsils*. These bodies, of an oblong form, and of a spongy and reddish

tissue, adhere externally to the constrictores pharyngis, which separate them from the internal carotids. Internally, they are convex, and present a great number of irregular sulci, filled generally by a viscid humour. The bottom of these depressions is pierced by the openings of the mucous follicles, the assemblage of which forms these organs. This reddish surface is often the seat of venereal ulcers, but when it is only inflamed to a slight degree, it presents sometimes an appearance which might be mistaken for the existence of an affection of this kind. When abscesses are formed in the tonsils, the pus may find its way spontaneously and externally, between the pillars of the palate; but if there should be much delay, the abscess must be opened as soon as its size renders respiration difficult. This operation, although very simple, might become fatal, if the instrument were introduced too deep, and if it were inclined too much towards the angle of the jaw, for then the internal carotid would be wounded. In fact, as Burns observes, the swelling of the tonsil diminishes the distance which separates this body from this vessel,—a distance which, in the natural state, is very small. In performing this operation, the instrument must be carefully inclined from before backwards, and not towards the angle of the jaw. In the operation for the division of the tonsils, the anatomical state of the parts must also be borne in mind. M. Boyer thinks, that if the complete extirpation of these organs is not altogether impossible, it is at least very difficult and dangerous. The excision of a portion of the tonsil is not generally followed by very great hæmorrhage; sometimes, however, the arteries which proceed from the inferior palatine, from the lingual and internal maxillary, ramify in this body, and are sufficiently large to furnish a great quantity of blood.

In the remainder of its extent the internal wall is formed by the alveolar arches and internal surface of the cheek (vide § 42): it does not present any thing which ought to detain us for the present.

§ 49. The posterior part of the inferior wall of the mouth gives attachment to the tongue, a fleshy body, of a pyramidal figure, flattened from above downwards,

and rounded on its angles, which fills the space between the inferior alveolar arch and the os hyoides. The base of this organ is fixed on this bone, and is continuous with the parietes of the pharynx, and with the epiglottis. The point, or anterior extremity of the tongue, is smooth and rounded; superiorly, it is almost flat and entirely free; is divided into two portions by a superficial sulcus, which occupies the median line, and which terminates posteriorly in a depression, which is called the foramen cæcum, or lacuna of the tongue: this small cavity is sometimes wanting, but it is generally about a few lines in depth, and receives the excretory canals of the follicles placed in its neighbourhood. The mucous membrane, which covers this part of the tongue, presents a great number of papillæ, which give it a roughish appearance, and which are divided, according to their shape, into lenticular, fungiform, and conical. The first, which are only mucous follicles, form, at the base of the tongue, two lines, which are directed from behind to before, and from without to within, and terminate at the foramen cæcum. The fungiform papillæ, placed on the borders and point of the tongue, are rounded and flattened, and appear to be supported by a short and narrow pedicle. The conical papillæ occupy the whole surface of this organ, between its circumference and the oblique lines formed by the lenticular papillæ. They are thinner at the anterior than the posterior part of the tongue, and appear to be of a nervous nature. The anterior third of the inferior surface of the tongue is free, and covered by the mucous membrane of the mouth, which is there very thin, and forms on the median line a fold, which is called the curb or bridle of the tongue, and which extends from the point of this to the level of the symphysis of the chin. The ranine veins, which can be seen through the mucous membrane, pass on each side of this fold, and proceed into the lingual.

There is very little cellular tissue beneath the mucous membrane of the tongue, excepting towards its base. This organ is chiefly formed of muscular fibres, differently interlaced. Some begin and terminate in the tongue, others have an extremity situated external to

this organ. The first, which constitute the intrinsic muscles of the tongue, or *lingual muscles*, form two layers, one transverse, the other longitudinal. The extrinsic fibres of the tongue proceed principally from the stylo-glossus, hyo-glossus, and genio-glossus, of which we shall soon have occasion to speak. In the middle of the fleshy tissue of the tongue we find, on the median line, a fibro-cartilaginous layer; posteriorly, it is continuous with the fibrous membrane which unites this organ to the body of the os hyoides; anteriorly, it is lost near the foramen cæcum, and gives attachment laterally to the transverse fibres of this part. The nerves of the tongue are furnished by the internal maxillary, the glosso-pharyngeal, and the hypo-glossal nerves, of which we shall speak hereafter, for, during their course in the tongue, they do not present any thing relating to the subject of which we are now treating. The *lingual artery*, which arises from the anterior part of the external carotid, as we shall see in describing the upper part of the neck, ascends between the genio-glossus and sublingual gland; arrived at the border of the tongue, it passes horizontally from before to behind up to the point of this organ, bearing the name of *ranine artery*, and is found immediately above the base of the filament of the tongue. Thus, when this fold requires to be divided, the point of the scissors must be carefully directed downwards, and not directly backwards or upwards, for then these vessels would be wounded.*

* The wounding of the ranine arteries is not the only danger to be apprehended from too great a division of the frænum linguæ. The frænum might be divided to so great an extent as to enable the tongue to be carried very far back into the mouth, or so far as the top of the larynx, and produce suffocation. It is reported of the negroes, that they possess very great mobility of the tongue, and, when tired of their lives, frequently kill themselves by throwing the tongue back into the larynx.†—T.

† {In commenting on this note, we may correctly say with the reviewer in the American Journal of the Medical Sciences, "that our life has been spent in the midst of a negro population, that we have frequently attended to their habits and diseases, and over and over again dissected them from head to foot, and that their tongues as well as all other parts of their organization, come precisely within the normal arrangement of the most approved Caucasian mo-

The part of the inferior wall of the mouth, which corresponds to the free portion of the tongue, is smooth and concave; we there observe on each side a kind of projection, directed obliquely from before to behind, and from within to without, and which is formed by the *sub-lingual gland*. This body, situated between the middle part of the lower jaw, the genio-glossus and hypo-glossus, and the mucous membrane of the mouth, is of an oval shape, and presents a great number of small excretory canals, which open between the tongue and gums. At the middle and posterior part of this portion of the inferior wall of the mouth, we find, on each side of the frænum linguæ, the openings from *the excretory canals of the maxillary gland*, or *Warton's ducts*. These openings, very narrow and turned forwards and a little upwards, are situated at the top of a kind of mamillary process. The parietes of this duct are very thin in the natural state, but they sometimes become very thick and resisting, when, in consequence of the obliteration of its orifice, saliva accumulates in it. The swelling, which is the consequence of this state, is called ranula; as it increases, it rests in front against the os maxillare inferius, and pushes the tongue upwards and backwards; it sometimes also occasions obstruction of the isthmus faucium, and suffocation.*

In order to complete the description of the parts which contribute to form the lower wall of the mouth, we ought to mention the muscles which proceed from the lower jaw to the os hyoides, &c.; but, as they equally form a part of the anterior and superior region of the neck, we shall describe them in Chapter VI.

del. It is therefore impossible for them, spontaneously, to swallow their own tongues, under any circumstances of grief or dejection of mind, and the clipping of the frænum linguæ with them as with others, must be an insignificant operation, so long as the genio-hyo-glossi muscles are left untouched." Notwithstanding, however, we should not be disposed to overlook the cases reported by Petit, in the third volume of his *Traité des Maladies Chirurgicales*, both of which proved fatal in consequence of the frænum being so much loosened as to permit the tongue to fall backwards into the pharynx, and suffocate the patients.—W.}

* {The operation for the cure of this disease, consists in laying open, or removing a portion of the cyst; after which the application of nitrate of silver may become necessary.—W.}

CHAPTER IV.

LATERAL REGION OF THE HEAD, OR AURICULAR REGION.

This region extends from the external orbitar process and the anterior border of the masseter, to the posterior edge of the mastoid process, and from the line which circumscribes the upper region of the head, to a second imaginary line proceeding from the top of this process to the inferior edge of the jaw. It is formed above and before by the base of the temporal fossa, beneath which we observe the zygomatic arch; before and below by the posterior part of the cheek; in the centre by the ear and the superior extremity of the neck, and posteriorly by the lateral and back part of the cranium. Towards its centre it presents the foramen auditorium externum, which is bounded behind by the lobe of the ear—a cartilaginous body of an irregular form, presenting projections and depressions which render its surface very unequal. The parts to be observed on it are, 1. The *concha*, a deep cavity which forms a kind of funnel round the meatus. 2. The *tragus*, a flattened and triangular eminence, situated in front of the meatus. 3. *Antitragus*, a conical projection situated opposite to the former, on the other side of the concha. 4. *Helix*, a kind of ridge, which commences above the meatus at the anterior part of the lobe, and is continued along its upper and posterior border. 5. *Antihelix*, a fold surrounded by the preceding; it commences near the antitragus, and goes above the concha towards the superior and anterior part of the lobe, where it bifurcates. 6. Lastly, the *lobule*, which forms the inferior extremity of this organ.

The skin which covers the ear is remarkable for its extreme fineness, especially on the different folds which we have just mentioned. It is very smooth, contains a great number of sebaceous follicles, and is covered by hair on the internal surface of the tragus only: it is continued into the external meatus, which it lines. It

is merely separated from the fibro-cartilage, which forms the basework of the lobe, by a layer of thick and serrated cellular tissue, and a few bundles of fibres, which constitute the proper muscles of this organ. A fold formed by this membrane, and filled with fatty cellular tissue, constitutes the lobule of the ear. On the mastoid process the skin is smooth, fine, and tense, but at a little distance from this it assumes all the characters of the scalp with which the superior region of the head is covered. In front of the ears the common integuments serve in man for the insertion of the hairs which form the beard; in females, on the contrary, the skin is smooth and devoid of hair. At the upper and anterior part of this region, *i. e.* the temple, the skin presents the same appearance as on the forehead, and beneath it is situated some cellular tissue, more loose and abundantly supplied with fat than at the upper part of the temporal fossa. The superficial fascia, after being united to the epicranium, attaches itself to the temporal aponeurosis, above the zygomatic arch. This arch, placed horizontally between the ear and the cheek, is formed by the temporal and malar bones; its external surface is only separated from the skin by the outer layer of the temporal aponeurosis which is attached to it, and by cellular tissue—from which circumstance the arch may be easily fractured. Its internal surface serves for the insertion of the inner layer of the same aponeurosis, and is separated from the temporal muscle by fat and cellular membrane, which establish a communication between the temporal fossa and the mass of fat situated between the masseter and buccinator muscles.

Above the zygomatic arch the layer of subcutaneous cellular tissue forms a kind of fascia, which is continuous superiorly with the temporal aponeurosis, in front with the adipose tissue of the cheek, below with the superficial fascia of the neck, and behind it is very closely united to the external auditory meatus. Near the ear, the fascia is more dense and resisting than in the other parts of this region; inferiorly it gives attachment to the upper extremity of the platysma myoides, and to the integument it is united by a loose and

thin layer of membrane. The arrangement of this aponeurotic layer exerts considerable influence on the characters which the abscesses that form beneath it present. Indeed its firm and unyielding texture prevents the swelling caused by the collection of pus from becoming very large, and renders the fluctuation obscure and equivocal, especially near the zygomatic arch and the auditory foramen, where it is very firmly attached to the subjacent parts. It is, therefore, evident that in cases of this kind the surgeon should not wait for the fluctuation to become very distinct before he opens the abscess, although it sometimes happens that the pus makes an opening into the external auditory meatus, and in this way spontaneously escapes.

Immediately beneath the superficial fascia the *parotid gland* is situated, the anatomical relations of which are very complicated and very important in a surgical point of view. It is a conglomerate gland of rather firm consistence, a reddish white colour, and an irregular pyramidal form. It consists of granulations united by very fine cellular tissue, extending from the zygomatic arch to about a quarter of an inch below the angle of the lower jaw, and from the external auditory foramen and mastoid process to half of the external surface of the masseter muscle. Externally it is rather closely connected to the superficial fascia, a process of which dips down on the inner surface of the gland, so as to envelop it on every side. This portion of the parotid sinks down very deeply between the ear and jaw and even beneath the ascending branch of this bone. It rests on the external surface of the masseter, the ascending branch of the inferior maxillary bone, the articulation of the jaw, the posterior edge of the internal pterygoid. It also rests in front of the ear, the sterno-mastoid and digastric muscles, the styloid process, the stylo-hyoidei and glossi muscles, and the external carotid. Lastly, from the upper part of the anterior edge of the parotid gland the *Stenonian duct* arises; it proceeds from before to behind, following the direction of a line drawn from the antitragus to the angle of the mouth. The duct rests on the external surface of the masseter, at a distance of about four or five lines from

the zygomatic arch. It is frequently surrounded by a portion of gland to the level of the anterior edge of the masseter; at other times it separates sooner, and then proceeds immediately beneath the subcutaneous fascia. There are several lymphatic ganglia close to the duct, and when they enlarge, its direction becomes changed.

Near the superior and anterior border of this gland we observe several filaments of the *facial nerve*, escaping from it to ramify on the temple and cheek. Leaving the cranium by the stylo-mastoid foramen, the trunk of this nerve furnishes to the neighbouring parts several branches, the most considerable of which are the posterior auricular, the stylo-hyoidean and submastoidean branches. It then sinks down into the substance of the parotid gland, proceeds obliquely downwards, forwards, and outwards, and, after the distance of seven or eight lines, it divides into two branches; the one called *temporo-facial*, the largest, goes forwards and upwards to the neck of the jaw, and ramifies on the temple and face. The other, *cervico-facial*, descends towards the angle of the jaw, and subdivides into a great number of filaments, which ramify on the os maxillare inferius and the upper part of the neck.

At the superior and posterior angle of the parotid gland, the temporal vein and artery are situated. The *superficial temporal vein*, after joining the deep vein of the same name, descends in front of the ear, dips into the substance of the parotid, furnishes a deep branch which goes above the digastric, and opens into the internal jugular vein. Lastly, it joins the internal maxillary vein, and leaving the gland at its posterior and inferior extremity, descends nearly vertical on the integuments of the neck, and takes the name of external jugular.

When the *carotid artery* arrives beneath the digastric muscle, it mounts vertically between the ear and ascending branch of the lower jaw, and penetrates into the substance of the parotid, close to its inferior edge, and the stylo-hyoideus muscle. It gives off the *posterior auricular artery*, a small branch which goes upwards and backwards through the substance of the gland near the mastoid process, and ramifies on the internal surface of the ear and the posterior part of the head.

The external carotid then gives origin to the *masseterine artery*, which ramifies on the muscle of the same name. On the level of the neck of the jaw, it divides into two branches, the temporal and internal maxillary. The latter sinks beneath the jaw; the former, on the contrary, continues its course from below upwards, towards the superior and posterior angle of the parotid. After escaping from this gland, it winds beneath the anterior and superior muscles of the ear, gives off the deep temporal, and becomes subcutaneous. (Vide § 4.) Immediately above the bifurcation of the external carotid, the temporal sends off the *transversalis faciei*, a branch which proceeds across the face between the Stenonian duct and the zygomatic arch, on the external surface of the masseter. Sometimes, but rarely, this artery arises from the external carotid. Before entering into the substance of the parotid, this vessel (the external carotid) is connected, by its inner surface, with the internal carotid, and higher up with the stylo-pharyngeus and glossus muscles, the styloid process and the aponeurosis extending from this process to the angle of the jaw. The trunk of the hypoglossal nerve, which leaves the cranium by the anterior condyloid foramen, is situated on the posterior surface of this vessel.

The *internal carotid* is situated in front, and to the inner side of the external; its inner surface is only separated from the mucous membrane of the pharynx and the tonsil by cellular tissue and the superior constrictor of the pharynx. Anteriorly it is in relation with the *internal jugular vein*, which leaves the cranium at the foramen lacerum basis cranii and descends behind the styloid process and the muscles inserted into it. The *pneumogastric* (par vagum), glosso-pharyngeal, and spinal accessory nerves, leave the cranium by the same opening. The first descends on the outer side of the carotid artery and behind the internal jugular vein. The *glosso-pharyngeal* goes downwards and forwards beneath the stylo-glossus muscle, then between it and the stylo-pharyngeus, till it reaches the inferior and posterior extremity of the tongue. The *spinal nerve* passes behind the internal jugular vein, in front of the

sterno-mastoid muscle, through which it passes at its upper third. Lastly, behind the internal carotid artery, we find the superior cervical ganglion, which separates it from the *recti antici capitis*, and the anterior surface of the vertebral column.

From this anatomical description, it is evident that the extirpation of the parotid gland, when this organ has become scirrhous, must be an operation extremely difficult of execution.* Indeed, it is impossible to do it without opening the external carotid artery, and dividing the trunk of the facial nerve, which necessarily produces paralysis of the muscles of the corresponding side of the face. If the whole tumour be not extirpated, and a portion of the scirrhus be left at the bottom of the wound, we may expect to see the disease return. If the operator, to avoid this fault, carries his instrument below the situation of the upper part of the gland, it is very probable that he would wound the internal carotid artery, which passes in front of the styloid process, or the internal jugular vein, which is situated immediately behind this process. Several authors have

* There is no doubt that in the majority of the cases in which the parotid is said to have been extirpated, a conglobate gland, situated in the substance of the parotid or its neighbourhood, has been mistaken for it. But Burns's assertion (vide Surgical Anatomy of the Head and Neck, p. 267), that the removal of this gland is impracticable, has been disproved in modern times by the operation of Beclard, even admitting that the case related by Mr. John Bell was not a genuine one of scirrhous parotid. Burns had, however, a clear idea of the difficulties which stood in the way of the operation. "The arteries," he says, "are not our dread; they do not deter us from performing this operation, but the nitching of the gland into interstices, from which we cannot extricate it, leaves us no hope of clearing away all the diseased substances, without which any operation would prove abortive. This is our chief consideration, and this is the insurmountable obstacle, our only barrier." In a case of malignant induration of the parotid which I saw at the Hamburgh hospital under the care of Mr. Fricke, that surgeon adopted a plan of treatment, although not new in principle, still new in its application to an affection of this particular part. He tied the external carotid on the side affected; for some time after the operation, the tumour gradually decreased in size, but ultimately it went into a state of suppuration, and the man died.—T.

even denied the practicability of the operation, and have thought that in the pretended cases of extirpation of the parotid, a superficial tumour merely has been removed, which depressed and even caused atrophy of the gland. But the case published by Beclard proves that it is practicable. The operator should not, however, attempt to remove, by the first incision, the portion of scirrhus which is situated behind the jaw, for, from the swelling, the carotid could not be well secured, nor a ligature be applied at so great a depth; the patient might, therefore, die from hæmorrhage during the operation. It is better to remove first the greater part of the scirrhus after Beclard's plan, and then the remainder by small strokes of the knife, in order to be able to seize the carotid at the moment of its division. Moreover, it appears probable, that in the greater number of cases the parotid has been supposed to be extirpated when merely a superficial tumour has been removed. In fact, there is generally a lymphatic ganglion situated beneath the portion of the parotid which extends below the angle of the jaw, and another lodged in the centre of this gland, opposite the spot where the external carotid bifurcates. It frequently happens that these are enlarged, which gives rise to the mistake to which we have just alluded.*

* {A very careful and attentive examination of all the evidence before the profession, relative to the extirpation of the parotid gland; together with frequent observation of its relative anatomy, and repeated attempts at its removal from the dead body, have only served to strengthen us in the opinion, and for the reasons expressed by Colles and Allan Burns, that its entire and complete removal is utterly impracticable, without the certain destruction of the patient. But what is the nature of the evidence presented to us? Old Heister says, he has "happily extirpated many parotid glands," and although he alludes to the danger of hæmorrhage, seems to be aware of no other, and evidently considers it an operation of little moment—a *distinguished* surgeon *(operator)* of modern times, strips it even of this terror, and boldly asserts, that, having insulated it, he has extirpated it by efforts at "wrenching," and the only artery which required a ligature was the temporal—next we read in the *Revue Medicale for* 1826, of the operation performed by the distinguished Lisfranc, of Paris; of a "tedious, painful, difficult, and dangerous dissection, continued amidst appalling hæmorrhage, by which the patient was for a time deprived

At the anterior part of this region, we observe the *masseter muscle*, the external surface of which is covered posteriorly by the parotid gland, below by the platysma myoides, in the middle by the Stenonian duct, facial nerve, and transverse artery of the face, and above by the posterior extremities of the orbicularis palpebrarum, and zygomaticus major. In the intermediate spaces it is in contact with the subcutaneous cellular tissue. This muscle is of a quadrilateral form, and is attached on one side to the zygomatic arch, and on the other to the angle of the lower jaw. The internal surface covers the branch of the os maxillare inferius, the tendon of the temporal and the posterior part of the buccinator muscles, from which it is separated by a mass of fat and cellular tissue.

The portion of the *os maxillare inferius*, which is situated in this region, bears the name of ascending branch; the angle which it forms with the body of the jaw or horizontal portion varies according to age. In children this angle is extremely obtuse; in the adult, on the contrary, it is nearly straight, and these differences, we shall presently see, regulate very much the facility with which the jaw may be luxated. The branch of the inferior maxillary bone gives attachment externally to the masseter. Superiorly it forms two processes; the anterior more elevated than the posterior, and flattened both on its inner and outer side, is called the *coronoid process*. It gives attachment to the tendon of the temporal muscle. The posterior goes

of sense;" of "a large and powerful column of blood springing to the height of several feet from the bottom of the wound!" that it was necessary to pass a ligature around the temporal, transverse facial, auricular, mastoid, and internal maxillary arteries; and, finally, that "*gastro-enteritis*," the fashionable phantom of the day, followed the "complete removal" of the parotid gland, and notwithstanding "leeches," carried off the patient six weeks after the operation.—We conclude, therefore, with the author, that an enlargement of one of the lymphatic glands in the neighbourhood of the parotid has given rise to the many mistakes which have occurred. At the same time, we consider that the case reported by Lisfranc, conveys a valuable practical lesson, i. e. that a *like result* will follow our attempts to remove the whole of the parotid gland.—W.}

obliquely from without inwards, and from before to behind, and terminates in an oblong and convex eminence, called the *condyle of the jaw;* it is covered by cartilage, to be articulated with the *glenoid cavity* of the temporal bone. This cavity, which is not very deep, is directed downwards, outwards and forwards: it is composed of two parts—a posterior concave, and bounded behind by the glenoid fissure, and the anterior parietes of the external auditory opening; and an anterior concave from without inwards, formed by the transverse root of the zygomatic process. Internally this cavity is circumscribed by the spinous process of the sphenoid; thus, dislocation of the jaw, inwards, outwards, or backwards, is quite impossible. For the jaw to be dislocated forwards, it is necessary that the axis of the condyles form with the base of the cranium an acute angle, the apex of which is turned forwards, in place of forming an obtuse angle, the apex of which is turned in a different direction, as is the case in the adult when the mouth is closed, and in children, whatever may be the position of the jaw. In children, from the nearly horizontal situation of the ramus of the jaw, this accident seldom occurs—in adults, only when the mouth is closed. But in adults, every cause susceptible of separating the lower jaw beyond its natural limits may produce dislocation.

The internal surface of the ramus of the jaw presents inequalities at its inferior part, which serve for the insertion of the fibres of the *internal pterygoid.* This muscle is attached superiorly to the pterygoid fossa; the upper part of its external surface is separated from the branch of the jaw by a space, in which the vessels and nerves are lodged, of which we shall presently speak. The internal surface is connected superiorly with the circumflexus palati and the superior constrictor of the pharynx, and inferiorly with the maxillary gland.

The *external pterygoid*, which is lodged in the zygomatic fossa, and is of a pyramidal shape, is attached to the anterior part of the neck of the jaw; it proceeds inwards and forwards towards the internal surface of the pterygoid process, to which it is attached by its

base, as well as to the inferior part of the zygomato-temporal surface of the spheno-maxillary fissure. Externally, it is connected with the temporal muscle; internally, to the outer surface of the pterygoideus internus; inferiorly, with the upper parietes of the zygomatic fossa.

Between the sphenoid and external pterygoid muscles the trunk of the *inferior maxillary nerve* is situated, which leaves the cranium by the foramen ovale, and divides into two principal branches; the one superior and external, giving origin to the deep temporal, masseterine, buccinator, and pterygoidien twigs—the other inferior and larger, furnishing the dental, lingual, and auricular. The *lingual nerve*, situated first between the pterygoid muscles, and the constrictor of the pharynx, where it rests in apposition against the chorda tympani, descends obliquely between the internal pterygoid and the ramus of the jaw; then between the mucous membrane of the mouth, and the sub-maxillary gland as far as the duct, the course of which it follows to the inferior and lateral parts of the tongue. The *inferior dental nerve*, a little larger than the preceding, descends by its side between the two pterygoid muscles; then behind the branch of the jaw to the level of the inferior dental opening, into which it enters. This foramen is situated immediately below the point of the attachment of the internal pterygoid muscle, and is situated about an inch and a half from the temporo-maxillary articulation. The situation of this nerve explains how fracture of the neck of the jaw is sometimes accom panied with such acute pain.

The *internal maxillary artery*, as we have stated, leaves the external carotid on a level with the neck of the jaw, and dips beneath the bone by making a curve inwards and downwards; it then goes directly inwards, passing between the dental and lingual nerves, and giving origin during this course to the *arteria meningea media*. This branch passes directly from below upwards, beneath the external pterygoid to the foramen spinosum, by which it enters the cranium. It then gives off the *inferior dental branch*, which proceeds between the internal pterygoid and the branch of the jaw,

behind the dental nerve to the orifice of the inferior dental canal, into which it penetrates, to be distributed to the teeth and chin. The small distance which exists between the posterior portion of this canal and the roots of the last great molar tooth, explains why the extraction of this tooth is sometimes followed with such copious hæmorrhage; for the dental artery may be easily wounded during this operation. After having given off these branches, the internal maxillary artery passes between the two pterygoid muscles, goes a little forward towards the maxillary tuberosity, and furnishes the *posterior deep temporal*, *the masseterine and pterygoidien branches*. The artery then makes a curve and becomes vertical, to pass between the points of attachment of the external pterygoid, and reach the botton of the zygomatic fossa, where it is lodged between the temporal muscle and the bony parietes of this cavity. During this course it gives origin to the buccal, anterior deep temporal, alveolar, and infra-orbitar; lastly, when the artery arrives towards the floor of the orbit, the vessel takes an horizontal and transverse direction, sinks into the fat and cellular tissue, which fills the spheno-maxillary fossa, and divides into four branches, called the *vidian*, *pterygo-palatine*, *superior-palatine*, and *spheno-palatine*. All these vessels, with the exception of the middle meningeal artery, are accompanied with veins, which open into the jugular. Lastly, at the top of this fossa the *ganglion* of Meckel is situated, a small reddish body, which sends off the spheno-palatine, palatine, vidian, &c.

The *zygomatic fossa* is a cavity situated between the posterior edge of the external ala of the pterygoid process and the crista which descends from the malar tuberosity of the superior maxillary bone, and which separates the canine fossa from the maxillary tuberosity. In front it is formed by the posterior surface of the malar bone, and by the tuberosity on which the orifices of the posterior dental canals are situated—openings by which the branches of the alveolar artery enter the alveoli. Inferiorly, the maxillary tuberosity articulates with the os palatinum, which in its turn articulates with the pterygoid process of the sphenoid that forms

the posterior parietes of this fossa. The space which exists between the maxillary tuberosity and the pterygoid process is called the *pterygo-maxillary fissure.* It unites nearly at right angles with the spheno-maxillary fissure, and leads into the fossa, which bears this name. This cavity, rather deep and narrow, is continued behind, and a little below the orbit, and is formed by the superior maxillary bone in front, the palatine internally, and the sphenoid posteriorly. We observe at its posterior and inferior part the internal orifice of the *foramen maxillare inferius* (for. rotundum), which gives passage to the second branch of the fifth pair, and which we have already traced through the top of this cavity to get into the spheno-maxillary fissure and infra-orbitar canal. 2. That of the *vidian canal*, which traverses from before to behind the base of the pterygoid process, and gives passage to the vessels and nerves of the same name. 3. That of the *pterygo-palatine canal*, a space left between the suture formed by the palatine and sphenoidal bones being traversed by an artery which, like the vidian, is distributed to the superior part of the pharynx. At the internal part of this fossa, we find the *spheno-palatine foramen*, which opens at the posterior part of the upper meatus of the nares, and gives passage to the *spheno-palatine artery*. Lastly, at the inferior part of this cavity, the superior orifice of the *anterior palatine canal*, the existence of whose anterior opening we have already mentioned, at the posterior part of the roof of the palate.

Behind the temporo-maxillary articulation, we observe the *external auditory meatus*, the orifice of which is situated at the bottom of the concha, about four lines in length, and three in breadth. The length of the meatus is ten or twelve lines; its direction is oblique from without inwards and from behind forwards, and its axis forms with that of the infundibuliform cavity, of which it is a continuation, an angle of about sixty-nine degrees. It is also slightly curved, and presents a slight convexity upwards. Its internal extremity is divided obliquely from above downwards and within outwards, and is closed by the membrane of the tympanum which separates it from the cavity of this name. From the

oblique direction of this membrane, it is evident that the inferior parietes of the auditory meatus is longer than the superior, for which reason it is necessary in extracting a foreign body from the meatus to introduce the instrument along its lower parietes. Another reason in favour of this precept is, that the vertical diameter of this tube being greater than the transverse, the foreign body, if it were round and occupied exactly, the transverse diameter would necessarily allow, in the other direction, a space through which the instrument might pass beneath it.

The parietes of the meatus are in part fibro-cartilaginous and in part osseous. The first portion is formed by a triangular fold bent on itself, and the base of which is continuous with the tragus and the anterior and inferior part of the concha. Above and behind it does not completely line the auditory passage, and internally and anteriorly it is intimately united to the edge of the osseous portion. We may also observe two or three transverse folds which are filled by fibro-cellular tissue, and which are called the incisuræ of Santorinus. It is through these openings that the pus collected beneath the sub-parotidien fascia sometimes penetrates into the meatus and makes its escape. The bony part formed by the temporal is longer than the cartilaginous portion. The skin which lines this canal firmly adheres to the subjacent parts, and covers a great number of small glands which secrete the wax; at the bottom of the meatus it is reflected on the membrane of the tympanum, so as to form a cul de sac. In some cases of deafness, great benefit has been derived by perforating the membrane of the tympanum.* In

* The perforation of the membrane of the tympanum was first performed on the human subject by Eli, a Swiss, in 1760. Some have supposed that Cheselden performed this operation; he certainly tried the experiment of breaking the tympanum in both ears of a dog, to see what effect would be produced on the power of hearing; and not finding it diminished, he recommended the operation. "It may be concluded," he says, "that the membrana tympani, though useful in hearing, is not the seat of that sense; and if any disease in that membrane should obstruct the passage of sounds to the internal parts of the ear, which are the seat of that

this operation the membrane should be perforated at its lower part, so as not to wound the chorda tympani, and the manubrium of the malleus. Of the cavity of the tympanum and the internal ear, it is not our province here to speak.

The *mastoid process* is situated behind the ear, and gives attachment to the sterno-mastoid and splenius muscles. Abscesses of this part, situated immediately beneath the skin, present all the character of phlegmon; but they sometimes open into the meatus auditorius before the integuments give way. If, on the contrary, they are seated beneath the aponeurosis of the muscles, the swelling which they form is long, but not very considerable. They are in general preceded by severe pains, and frequently accompanied by a morbid state of the bone. The cells, large in proportion as the individual is advanced in years, occupies the interior of the mastoid process, and communicates with the cavity of the tympanum. In cases of deafness, attributed to the obstruction of the Eustachian tube,* some surgeons have advised this perforation; but, at present, it is seldom practised, excepting in caries of the bone.

In order to complete the description of this region, we should speak of the upper extremity of the pharynx, which is situated at the base of the cranium between the vertebral column and the posterior openings of the

sense, an artificial passage through that membrane might recover hearing, as the removing the crystalline humour, when that obstructs light, recovers sight."—*Cheselden's Anatomy*, Edit. 5th, 1740, p. 306.

Sir Astley Cooper was, however, the first to carry this operation into execution on the living subject in this country, and in an admirable paper published in the Phil. Transactions for the year 1801, stated distinctly under what circumstances the operation might be performed with a probability of success. The operation only relieves in cases of deafness arising from the closure of the Eustachian tube; but it has been so often performed without regard to this fact, that discredit has been thrown on the operation, and its real merits too much overlooked.—T.

* In the last case with which I am acquainted, where the perforation of the mastoid process was performed on account of deafness, arising from closure of the Eustachian tube, the life of a celebrated individual was sacrificed to the operation.—T.

nasal fossæ and mouth; but as this part extends some way into the anterior region of the neck, we shall defer speaking of it until the next chapter.

CHAPTER V.

ANTERIOR CERVICAL REGION.

§ 63. The narrow part of the trunk, placed between the head and the chest, and called the neck, is of a roundish form, but may, however, be divided into two regions, an anterior and a posterior one. The anterior region is bounded above by the base of the lower jaw, and the mastoid processes; below, by the sternum and clavicles; laterally, by a line, which nearly corresponds to the edge of the trapezius muscle, running from the posterior part of the mastoid process to the acromial extremity of the clavicle. The middle and superior portion of this region is bounded by the lower part of the chin, and the inferior wall of the mouth. We feel the os hyoides through the skin below, and still lower, the projection of the thyroid cartilage. When the base of the cranium is placed parallel to the horizon, the first portion of the neck is almost horizontal, and, in the adult, the os hyoides is situated about four or five fingers' breadth behind the chin, and a quarter of an inch below the edge of the jaw. In the median line, between the os hyoides and the thyroid cartilage, there is a slight depression, but there is none laterally. Below the thyroid cartilage we find a second hollow, corresponding to the space which exists between this organ and the cricoid cartilage. This last, like the body of the os hyoides, forms a semi-circular projection, and is situated at the top of the trachea and the thyroid gland, which can be felt through the integuments. Lastly, completely at the inferior and central part of this region, between the upper edge of the sternum and the tendons of the sterno-mastoid muscles, we find a

hollow, which corresponds to that portion of the trachea that is situated below the inferior edge of the thyroid gland. In the adult, the superior edge of the thyroid cartilage is about six fingers' breadth distant from the sternum, and the middle of this distance corresponds to the superior edge of the thyroid gland; but when the head is turned back, as is done in the performance of the greater number of operations on the neck, the relative position of the parts which we have just mentioned is considerably changed. In fact, the anterior part of the neck only forms an oblique line from the chin to the sternum, and a distance, of about four or five fingers' breadth, then exists between the chin and the superior edge of the thyroid cartilage. The distance between this edge and the superior one of the thyroid gland is about three fingers' breadth, and about four from this last point to the upper extremity of the sternum, in place of three, as in the ordinary position. It is important to recollect this, for it is in this part the operation of bronchotomy is performed.

On each side of the part just described, we notice the projection of the sterno-mastoid muscles, which approximate very much inferiorly, but diverge from each other as they ascend. It is the anterior edge of the sterno-mastoideus, as we shall afterwards see, which ought to guide us in tying the carotid artery, the pulsation of which may be felt between this projection and the larynx. External to the sterno-mastoid, at the inferior part of this region, we see a triangular hollow, circumscribed by this muscle before, behind by the projecting border of the trapezius, and below by the clavicle: we can here feel, through the integuments, the scaleni and levator scapulæ muscles, some lymphatic glands, the brachial plexus and the pulsation of the axillary artery. In general, the extent of this triangular space is greater in the female than in the male; but it may vary from an inch and a half to three inches, according to the individual. The base is bounded by the clavicle; this bone is naturally directed from above downwards, and from behind forwards; but it may change its direction, either by the displacement of its acromial, or the elevation of its sternal extremity. The

height at which it is found may also vary, according to its greater or lesser degree of convexity, or as it may be totally raised by an aneurismal tumour; but, whatever may be the cause of this anomaly, it is always a troublesome circumstance in the operation for tying the subclavian artery, an operation in which we make the external incision parallel to the superior edge of this bone, between the sterno-mastoideus and the trapezius muscles.

The skin which covers the anterior region of the neck is, in general, white, fine, and soft: we remark many transverse wrinkles in it, arising from the contraction of the platysma myoides, and, in the adult male, hairs on the sub-buccal portion, which form part of the beard.

§ 64. Immediately under the skin, we find the superficial fascia, and between its two layers, the platysma myoides. This muscle is quadrilateral and very thin: it is attached inferiorly to the subcutaneous cellular tissue that covers the deltoid and pectoralis major; higher up its fibres are directed obliquely upwards and inwards, and are lost above the lower jaw on the inferior part of the cheek. On the chin the anterior part of the muscle is confounded with that of the opposite side, but it separates in descending, and thus leaves, on the median line, a triangular space, in which the two layers of the superficial fascia of the neck unite, and form a thick and resisting membrane. This fascia is continuous superiorly with that which covers the parotid gland: on the side of the neck it forms a dense layer, which, on the upper portion of the sterno-mastoid muscle, adheres strongly to the skin. Near the anterior edge of the trapezius, it loses its aponeurotic appearance; but it firsts sends off an elongation, which is attached to the temporal bone near the mastoid process, and which dips beneath the anterior edge of the sterno-mastoid muscle. Inferiorly, it is prolonged on the anterior surface of the sternum, under the form of subcutaneous cellular substance; and, on the upper edge of this bone, between the tendons of the sterno-mastoidei, it sends off an elongation, which proceeds backwards and downwards, and unites with another aponeurotic membrane.

The superficial fascia of the neck is formed by the subcutaneous cellular tissue: in very fat individuals it is indistinct, whilst, in lean and anasarcous subjects, it has the appearance of an aponeurotic membrane; but it is chiefly when tumours exist in this region, that it becomes strong and resisting: we, however, never perceive muscular fibres in it.

§ 65. The *external jugular vein*, which we have already seen descending from behind the parotid gland, upon the lateral part of the neck, continues its course immediately under the platysma myoides and the superficial fascia, towards the posterior edge of the inferior extremity of the sterno-mastoid muscle; it then descends vertically to reach the subclavian vein. During this course, it follows nearly the same direction as the fibres of the platysma myoides: when phlebotomy is performed here, it is, therefore, proper to make the opening more or less oblique in relation to these fibres.

A vein descends from the lateral part of the face, runs under the superficial fascia on the fore part of the neck, and along the anterior edge of the sterno-hyoid muscle, and often acquires a considerable size near the bottom of the neck, and communicates with that of the opposite side by a pretty large branch. In the operation of bronchotomy, this anastomosing branch may be opened in dividing the integuments; and the blood that escapes might embarrass the surgeon, but it will not be productive of any bad consequence. In fact, this vessel, as well as its lateral branches, being situated immediately under the superficial fascia, and above another aponeurosis still deeper, which we shall presently notice, the blood will escape externally with greater ease than it can flow into the trachea.

§ 66. Under the superficial fascia of the neck, we find a second aponeurotic cellular membrane, which constitutes the deep fascia: it is fixed superiorly along the edge of the lower jaw, is continued laterally with the stylo-maxillary ligaments, and divides into two layers, to surround the sub-maxillary gland: it is attached to the projecting part of the thyroid cartilage, and again forms two layers. The anterior layer is extended upon the tendons of the sterno-mastoid muscles, and becomes

continuous with the superficial fascia on the anterior edge of the sternum; the posterior proceeds to the posterior surface of the sternum, and is separated inferiorly from the anterior layer by a quantity of fatty cellular substance, which generally incloses some lymphatic glands. Upon the sides of the neck, this fascia degenerates into cellular tissue: its appearance also varies much, according to the individual; sometimes it is thin and cellular, at other times it is thick, and almost as distinct as the aponeurosis of muscles.

One of the principal uses of the cellular layers, which surround the inferior part of the neck, is to resist the pressure of the atmosphere in the moment of inspiring, and to prevent the trachea from being compressed by this force each time the thorax dilates. Thus, when in consequence of an ulcer, or other causes, these fasciæ and the sterno-hyoidei and sterno-thyroidei muscles placed under them are destroyed, the parts which at this point close the top of the thorax are not sufficient to resist the pressure of the atmosphere, and, when the chest dilates, they are forced inwards, and by pressing on the trachea, produce a considerable difficulty in breathing.

Some lymphatic ganglia, as we have said, are found above the edge of the sternum, in the adipose mass situated between the superficial and deep fasciæ. When these glands enlarge, a tumour arises which may be mistaken for a morbid state of the thymus gland; but it does not produce the same degree of dyspnœa, the deep fascia preventing it from compressing the trachea. We also find lymphatic glands in other parts of the neck: some are placed above, and others below the fascia; and from these differences of situation arise great varieties, both in the characters and treatment of the tumours which they form. In fact, tumours situated between the integuments and cervical fascia are superficial, circumscribed, prominent, and moveable. For a long time, by pulling these tumours outwards, we can raise them sufficiently to be able to pass the fingers between their base and the neighbouring parts. They, however, form connexions at last with the fascia behind them, and cause either a

thickening of that membrane and its adhesion to the adjoining parts, or else its absorption, in which case they sink among the deep parts to which they also become adherent. Therefore, when, from their anatomical structure, extirpation is deemed advisable, the operation ought to be performed without delay, before adhesions form. The tumours which form under the cervical fascia are more frequent and more dangerous than those that form above that membrane. The resistance which this fascia offers to their development, flattens them, and prevents the appearance of any external projection, before they have acquired a very considerable size. They, therefore, can only extend inwards and sink between the muscles, vessels, and other deep parts; their extirpation is, consequently, attended with very great difficulty. This circumstance explains why these tumours occasion a difficulty in breathing, much more severe than their size would lead us to expect.

§ 67. Under the parts we have mentioned, we see the sterno-mastoid muscle and the os hyoides, which divide this region into three distinct portions, viz., the sub-maxillary, which extends from the lower jaw to the os hyoides and the sterno-mastoid; the second, the sub-hyoidean, bounded by the os hyoides, the sternum, and the sterno-mastoid; the third, or supra-clavicular, situated behind the last muscle, above the clavicle, and before the trapezius. The *sterno-mastoid muscle* is a long, flattened, fleshy bundle, about two inches broad, narrower in its middle than at its extremities, and situated at the lateral and anterior part of the neck. Its inferior extremity is bifurcated, to be implanted into the sternum and the anterior part of the clavicle; it then runs obliquely upwards, backwards, and a little outwards, to be fixed to the mastoid process, and to the external third of the superior ridge of the occipital bone. The anterior edge of this muscle corresponds with a line drawn from the anterior part of the mastoid process to the centre of the upper extremity of the sternum.

§ 68. The *os hyoides*, formed of five distinct pieces susceptible of moving on each other, is situated transversely at the superior part of the neck. The middle

bone, or *body of the os hyoides*, is quadrilateral and flattened from before to behind. The external surface is convex, irregular, and presents on the sides two small fossæ, separated by a ridge. The two lateral portions, or *great cornua of the os hyoides*, are long and narrow, and are articulated by their anterior extremity with the sides of the body of the bone. Lastly, the two superior, or small cornua, are short, pyramidal, inclined backwards and upwards, and placed above the point of union of the body with the great cornua.

§ 69. Above the os hyoides, and immediately under the platysma myoides and the fascia of the neck, we find the *digastric muscle*, which is thick and fleshy at its extremities, and tendinous in the middle. The anterior belly of this muscle is fixed to the internal surface of the lower jaw; it then descends obliquely backwards towards the upper edge of the os hyoides, where it becomes tendinous, and passes through an opening in the tendon of the stylo-hyoideus muscle,* being attached to this bone. The posterior belly then runs obliquely backward, upward, and outward, passes across or before the inferior extremity of the stylo-hyoid muscle, and terminates under the trachelo mastoideus, splenius, and sterno-mastoid, at a groove on the inferior surface of the temporal bone, behind the mastoid process.

§ 70. The triangular space found between the upper edge of this muscle and the lower jaw, is almost entirely filled by the sub-maxillary gland. This gland is lodged, as already mentioned (§ 66), between two layers of the deep fascia; it is considerably smaller than the parotid, of an oval, irregular form, and flattened on three sides. Behind, it extends as far as the angle of the jaw, and is united by loose cellular tissue to the lower extremity of the parotid gland.† Its an-

* {The fibres of the stylo-hyoideus muscle, as they proceed to their insertion into the os hyoides, split into two portions, and through the opening thus formed by the splitting of its fibres, the tendon of the posterior belly of the digastricus muscles passes, and not, therefore, through "an opening in its tendon."—W.}

† {A distinct layer from the fascia superficialis will be found to pass between these two glands, so as to separate them completely from each other.—W.}

terior extremity is divided into two portions, one of which, being superficial, advances towards the digastric, and the other, deep, lies under the mylo-hyoid muscle, and joins the sublingual gland. Its external surface lies close upon the internal pterygoid muscle and the internal surface of the lower jaw. Its lower surface is covered by the platysma myoides and the sub-cutaneous aponeurotic layers; we frequently find two lymphatic ganglia here, which correspond with the two lobes which this gland usually forms. When these glands increase in size, they push the sub-maxillary gland behind the jaw, and form a tumour, which may easily be mistaken for a scirrhous state of that organ. It is even probable, that in the greater number of cases, where it has been supposed that this gland has been extirpated, these ganglions were merely removed, though from their morbid condition they were not distinguishable from the gland itself.

The internal surface of the sub-maxillary gland is in connexion with the middle of the digastric, and with the stylo-hyoid, stylo-glossus, and mylo-hyoid muscles, the lingual and hypoglossal nerves, and the facial artery. Lastly, the excretory duct arises from its anterior and superior part, and proceeds forwards and upwards, between the mylo-hyoid and genio-glossus muscles, towards the inferior wall of the mouth (see § 49).

§ 71. The *mylo-hyoid* muscle, covered by the digastric, platysma myoides, and the sub-maxillary gland, is thin, flattened, of a triangular form, and directed obliquely from above downwards and inwards; superiorly, it is fixed to the internal oblique line of the lower jaw, from the symphysis as far as the first molar tooth; inferiorly, it is attached to the body of the os hyoides; before, it is united with that of the opposite side, and forms a kind of tendinous raphé, which extends from the chin to the os hyoides. Its internal surface covers the genio-hyoid, genio-glossus, and hyo-glossus muscles, the sub-lingual gland, and the lingual nerve.

§ 72. Behind the sub-maxillary gland, and under the posterior belly of the digastricus, we find the *stylo-hyoid* muscle. This long, thin, fleshy bundle follows the same direction as the last, and is fixed to the body

of the os hyoides and the styloid process, near its base. It covers the external carotid, facial, and lingual arteries, the internal jugular vein, the stylo-glossus, stylo-pharyngeus and hyo-glossus muscles, and *hypo-glossal nerve.* This nerve leaves the cranium by the anterior condyloid foramen, and then passes between the internal carotid artery and the internal jugular vein, a little below the level of the inferior edge of the jaw, then under the termination of the facial vein, and upon the external carotid artery. Beneath the tendon of the digastric, it sends off a descending branch, and forms an angle in its ascent towards the tongue, betwixt the mylo-hyoid and hyo-glossus muscles.

§ 73. The *facial artery*, which arises from the fore part of the external carotid, behind the digastric, goes almost transversely inwards and forwards to the angle of the jaw, passing under the hypo-glossal nerve, the digastric and stylo-hyoid muscles, and the sub-maxillary gland, in the substance of which it is occasionally more or less deeply lodged. It then bends between that gland and the base of the lower jaw, and mounts towards the angle of the mouth (see § 39). In this course it is very tortuous, and sends off the inferior palatine branch, which is distributed to the pharynx, a number of branches to the sub-maxillary gland, and the *sub-mental branch*, which runs from behind forwards, under the inferior edge of the jaw, between the platysma myoides, the digastric, and mylo-hyoid muscles, as far as the median line, where it bifurcates, to anastomose with that of the opposite side, and to send a branch to the chin.

The *facial vein* does not accompany the facial artery under the sub-maxillary gland, but passes behind its posterior extremity, and opens into the internal jugular vein, immediately under the edge of the digastric muscle.

When tumours are extirpated from this part of the sub-maxillary space, a lesion of the facial artery is almost inevitable, especially when the tumour is formed by the sub-maxillary gland, or has taken the place which this gland usually occupies. These considerations have induced Mr. Velpeau to imagine that, in cases of this

kind, we ought to begin by tying this vessel, which can be readily found between the cornu of the os hyoides and the sub-maxillary gland, by making an incision from this last organ to the fore part of the sterno-mastoid muscle. When the head is neither turned forwards nor backwards, all the parts which we have noticed as being lodged in the sub-maxillary space, are more or less concealed by the lower jaw; but when we turn the head back, the hollow which exists between this bone and the mylo-hyoid muscle is greatly diminished, and the organs in this part are pushed outwards, and become more accessible to the operator. We ought to recollect that this position facilitates the extirpation of tumours from this part.

§ 74. Under the mylo-hyoideus, on the fore part of the neck, we find the *genio-hyoideus*, fleshy, slender, and short; it is fixed to the lower part of the symphysis of the jaw, and to the body of the os hyoides; its internal surface lies upon the genio-glossus and *hyo-glossus*. The last is thin, broad, and quadrilateral; it is fixed to the upper surface of the larger cornu of the os hyoides, to the internal surface of that bone, to its smaller cornu, and mounts on the side of the base of the tongue, in the substance of which it is lost. Its external surface is covered from above downwards by the stylo-glossus and mylo-hyoideus, and the hypo-glossal nerve, the sub-maxillary gland, and the genio-hyoid, stylo-hyoid, and digastric muscles. The *genio-glossus* is triangular, and flattened transversely; its fibres are fixed to the superior process of the chin, from which they proceed to terminate in the tongue, from its base to the extremity. The external surface is covered by the sublingual gland, and by the stylo-glossus, hyo-glossus, and mylo-hyoides; its internal surface is contiguous to that of the opposite side.

§ 75. *The lingual artery*, which arises behind the digastric, from the external carotid, a little under the facial, runs in a serpentine direction upwards and forwards, until it reaches the larger cornu of the os hyoides; in this course it is in contact with the hypo-glossal nerve: near the insertion of the hyo-glossus into the body of the os hyoides, it runs horizontally forwards,

passes between the hyo-glossus and the constrictor pharyngis inferior. It then ascends between the hyo-glossus and genio-glossus, and afterwards between this last muscle and the sub-lingual gland as far as the base of the tongue, where it changes its direction and name (see § 49). Until the lingual artery arrives at the junction of the cornu of the os hyoides with the body of that bone, it is only covered by the skin, the platysma, the fasciæ of the neck, the lingual nerve, and the hyo-glossus; but, when the artery advances forward to sink into the substance of the tongue, it is necessary, in order to reach it, to divide not only the skin, the platysma, and the fasciæ, but also the anterior belly of the digastricus, the mylo-hyoideus, and the genio-hyoideus. The most convenient place, therefore, to tie this vessel, is where it runs parallel to the larger cornu of the os hyoides: it is then rather superficial, and is neither in contact with many muscles nor more than one nerve. This operation is, indeed, seldom necessary; but, as Burns observes, by doing it we may extirpate a large part of the tongue without danger from hæmorrhage.*†

After the descriptions which we have given both in this and the preceding chapter, of the anatomical situations of the parts that surround the lower jaw, it is evident that, in the removal of this bone, the difficulty and danger will be increased according to the extent of the part removed. Its anterior extremity is not in contact with any large arterial trunk; but behind the mental foramen it is in contact with the facial artery: we are, therefore, in general, obliged to tie this vessel in the operation; the lingual artery and the internal maxillary may also be equally concerned. Lastly, the

* This operation was performed some time ago by Mr. Norman of Bath. Mr. Norman had occasion to remove a large portion of the tongue on account of a cancerous affection of this organ, and very properly first secured both lingual arteries.—T.

† {A very considerable portion of the tongue may be removed without the slightest danger from hæmorrhage, by employing a needle armed with a double ligature. The needle should be introduced beyond the disease, the ligature then divided, and the two extremities tied in such a manner as to include the whole of the diseased portion.—W.}

destruction of the anterior point of attachment of the muscles which raise the base of the tongue and the larynx in deglutition, may sometimes render this movement difficult, or even impossible; but the observations of MM. Dupuytren, Graefe, Mott, and M'Clellan, prove that this danger is not so great as some surgeons have imagined, and that almost the whole of the lower jaw may be removed without any serious inconvenience ensuing.*

§ 76. Betwixt the os hyoides and the sternum, immediately under the cervical aponeurosis, we find the *sterno-hyoideus*, a long, narrow, and thin, fleshy bundle. It is attached to the upper and inner part of the ster-

* In the fourth volume of the Dublin Hospital Report, recently published, there is an account of several operations performed on the lower jaw. Mr. Cusack has related seven cases, in three of which he amputated a considerable portion of the bone, with perfect success, and in the other removed the bone from the articulation on one side. Of the latter cases one died; the death of the patient being occasioned by erysipelas, which supervened on the operation. Mr. Crampton, in an excellent paper on osteo-sarcoma, has given two cases in which he performed amputation of a portion of the lower jaw with success. And very recently, in this city, Mr. Wardrop has performed the same operation with the same good result.†—*Vide Lancet*, No. 188. vol. xii.—T.

† {This operation has been frequently performed in this country within the last few years. In the first cases operated on by Professor Mott, of New-York, as a precautionary measure, to guard against hæmorrhage, and subsequent inflammation, he passed a ligature around the common carotid artery, before proceeding to the removal of the diseased bone. From similar views, about the same time, Graefe, of Berlin, pursued the same course, and many surgeons subsequently adopted the practice.

The more recent experience of Cusack, Crampton, and others, both in Europe and this country, incline us to the belief that the ligature of the carotid in the great majority of cases is highly improper, inasmuch as it materially increases the dangers of the operation, and adds considerably to the sufferings of the patient. In a letter we some time since received, from our distinguished friend, Professor Mott, he expresses his conviction that there are many cases in which the carotid ought not to be tied, and further observes, that "the results from tying the carotid have been so gratifying in regard to hæmorrhage and subsequent inflammation, when the operation has been extensive, that it has established with him an important fact in operative surgery."—W.}

num, and mounts obliquely upwards and inwards, approaching the muscle of the opposite side on the middle of the larynx; it then runs a little outwards, and terminates on the lower edge of the body of the os hyoides. Its anterior surface is covered by the clavicle, the sterno-mastoideus, omo-hyoideus, platysma, and the cervical aponeurosis. In the space between the sterno-hyoidei, on the median line, proceeding from above downwards, we see the middle portion of the thyro-hyoidean membrane, the projection of the thyroid cartilage, the crico-thyroidean membrane, the cricoid cartilage, the thyroid gland and the trachea, all of which we shall hereafter notice.

The *sterno-thyroideus*, placed under, and a little behind the sterno-hyoideus, has the same form as the latter, but it is a little shorter and broader. It is attached to the inner side of the sternum on the level of the cartilage of the first rib, and then, turning a little outwards, ascends to the thyroid cartilage to which it is fixed. The anterior surface of this muscle is in contact with the sterno-hyoidei. Its upper extremity is united to the *thyro-hyoideus*, a thin, quadrilateral muscle, which is attached to the thyroid cartilage, to the inferior edge of the body of the os hyoides, and also to the anterior half of the external edge of the larger cornu of that bone. Its anterior surface is covered by the sterno-hyoideus, omo-hyoideus, and the platysma myoides.

The *omo-hyoideus* is situated at the lateral and anterior part of the neck: it is inserted into the inferior edge of the body of the os hyoides, and runs obliquely downwards, backwards, and outwards; passes under the sterno-mastoideus, which it crosses; runs under the clavicle, and is fixed to the upper edge of the scapula behind the coracoid notch. The course of this muscle corresponds pretty exactly with a line, drawn from the side of the body of the os hyoides to near the middle of the clavicle, but a little nearer the sternum. We shall afterwards see, that it is important to recollect the direction of this line, as well as that of the anterior edge of the sterno-mastoideus, in the operation for tying the carotid artery (see § 67.)

§ 77. The *larynx*, situated on the middle and an-

terior part of the neck, between the os hyoides and the trachea, is covered by the skin, the superficial fascia, the platysma, the deep fascia, the sterno-hyoid, sterno-thyroid, and thyro-hyoid muscles. Its upper edge is united to the posterior surface of the body and larger cornu of the os hyoides, by means of a yellowish, fibrous membrane, thicker in the middle than at the sides, and about fifteen lines in length: this is the *thyro-hyoid* membrane. The laryngeal branch of the superior thyroid artery runs from behind forwards, between the thyro-hyoideus and this membrane, which it then crosses with the laryngeal nerve, to be distributed to the internal parts of the larynx. This part of the neck is often divided in attempts at suicide; but the wound is commonly not mortal, even although the superior thyroid artery and some of its branches are divided, and copious hæmorrhage ensues.

The *thyroid cartilage*, which forms the upper and anterior part of the larynx, seems formed of two quadrilateral plates, united at an acute angle on the median line; it is about an inch long, and has on the side an oblique crest running from before backwards, and from above downwards, which gives attachment to the sterno-thyroid and thyro-hyoid muscles. The internal surface of this cartilage has an angle anteriorly, in which the ligaments of the glottis and the thyro-arytenoid muscles are fixed. Its inferior edge is hollow, where it gives attachment to the crico-thyroid muscles; the middle hollow gives attachment to the crico-thyroid membrane, and it is larger than the lateral hollows, from which it is separated by a tubercle, where the oblique lateral crest terminates.

The *cricoid cartilage*, situated under the former, has an angular form, and ascends much higher behind than before. The space occupied by the crico-thyroid membrane, and included between the two muscles of the same name, and the two cartilages we have mentioned, is of a triangular form, and about three or four lines in height, and five or six in breadth. It is in this part that bronchotomy is performed after the plan of Vicq d'Azyr, a plan that is preferable to all others, when the object of the operation is simply to admit air

into the larynx. In fact, the crico-thyroid membrane is only covered by the skin, the fascia of the neck, and the platysma: in this operation it is only necessary to avoid wounding the crico-thyroid branch, which arises from the superior thyroid artery, and passes transversely across the membrane, to anastomose with that of the opposite side on the median line. To do this, we must endeavour to feel the pulsations with the forefinger of the left hand, and turn the artery from the point where the knife pierces the membrane. Sometimes, as Shaw observes, a part of the thyroid gland passes above this triangular space and mounts towards the os hyoides: in this case we ought not to perform the operation of bronchotomy here; but fortunately this disposition is not found in more than one case out of ten. When foreign bodies are lodged in the ventricles of the larynx, Desault has proposed, that instead of making the vertical section of the trachea, which we have mentioned, we should divide the thyroid cartilage: in performing this operation, we first divide the crico-thyroid membrane, as in the preceding case; we then cut this cartilage from below upwards, the whole of its length. This operation is very easy, on account of the superficial situation and the projection of the thyroid cartilage; but in performing it we sometimes open veins so large as to require a ligature, and, however inconsiderable the crico-thyroid artery may be, provided its pulsation can be felt, it is always necessary to commence the incision above it.

The cricoid cartilage is articulated posteriorly, by its superior edge, with the arytenoid cartilages which close the larynx behind the thyroid cartilage. Its inferior edge is joined by a fibrous membrane to the first ring of the *trachea*. This tube, convex before and flattened behind, is formed of several fibro-cartilaginous rings placed in succession one above the other, and united by very short fibrous membranes. These rings form about two-thirds of a circle, the posterior part of the larynx being membranous. Its anterior and superior part is covered by the thyroid gland, the relation of which it is very important for the surgeon to bear

in mind—its posterior surface is in contact with the œsophagus.

§ 78. The *thyroid gland* is lodged in a duplicature of the deep fascia, which is sometimes very thick; this disposition also renders fluctuation, in case of abscess, extremely obscure, and retards a spontaneous opening. The size of this gland is in general larger in the infant than in the adult, and in the female than in the male. It is formed of two ovoid lobes, flattened from before backwards, thicker inferiorly than superiorly, and united above by a transverse portion, named the isthmus of the thyroid gland, and which varies much in extent. When these two lobes, instead of being united by a middle portion, neither very large nor very thick, are closely united together, as sometimes happens, we run the risk of cutting a considerable portion of it, when we perform laryngo-tracheotomy after Boyer's plan; an operation in which we introduce the cutting edge of the instrument under the second ring of the trachea, and cut from below upwards the superior portion of this canal, and also the cricoid cartilage. Burns says, he once found the middle portion of the thyroid gland placed between the trachea and the œsophagus; but, fortunately, this disposition is extremely rare, for if it existed when this gland augmented in size and became hard, both dyspnœa and dysphagia would be produced, against which all the efforts of art would be unavailing.

The anterior surface of the thyroid gland is convex, and covered by one of the laminæ which form its cellulo-aponeurotic envelopment, and by the sterno-thyroid and sterno-hyoid before, the platysma, omo-hyoid, and sterno-mastoid muscles laterally; these are covered by the fasciæ of the neck and the skin. When the thyroid gland becomes the seat of a tumour, the size of which increases slowly, this musculo-aponeurotic layer gradually yields, and only slightly compresses it; but the case is not the same when the progress of the disease, instead of being chronic, as in the goitre, &c., is acute, as in inflammation of this part. In fact, this membrane then strongly opposes the development of the tumour, throws it backwards, and, when it is of considerable size, produces very great difficulty in respiration and

deglutition. The part of the gland which is the seat of the disease has also a very marked influence on the severity of the symptoms. Thus, enlargement of the right lobe does not produce such serious symptoms as that of the left lobe or the middle portion; when the left lobe is affected the patient complains more of a difficulty in deglutition than of dyspnœa, whilst the contrary is the case when the middle portion is affected. The anatomical descriptions, which we shall presently give, will explain the causes of these differences.

The posterior surface of the thyroid gland is concave, and united to the larynx and the superior part of the trachea by means of cellular tissue; it also covers the crico-thyroid, thyro-hyoid, and inferior constrictor muscles of the pharynx. Its lateral edges are in contact with the common carotid arteries, the pneumogastric and inferior laryngeal nerves, and the anastomosing branches from the cervical ganglia; and lastly, but on the left side only, with the œsophagus, which explains why the deglutition is more impeded when the left lobe is enlarged, than when the disease is on the opposite side.

§ 79. The thyroid gland receives four principal arteries; these are the *superior and inferior thyroideal.* The first arises from the external carotid under the facial, runs downwards, forwards, and inwards, to the side of the larynx, then descends vertically under the platysma, omo-hyoid and sterno-thyroid, sending off laryngeal branches, and the crico-thyroid (§ 77); and when it reaches the upper edge of the thyroid gland, divides into three branches, the most considerable of which runs along the external edge of this organ. Another branch sinks between it and the sides of the larynx; lastly, the third keeps along its internal edge, and unites, before the cricoid cartilage, with that of the opposite side. The course of this artery renders the tying of it easy; in fact, we reach it without difficulty by making an incision parallel to the sterno-mastoideus, above the omo-hyoideus; or by dividing the parts from above downwards, and from behind forwards, from the cornu of the os hyoides to the inferior edge of the thyroid cartilage. This operation has been performed for

the goitre; but in the case where Sir William Blizard performed it. the disease did not terminate fortunately, although the size of the tumour diminished one-third in fifteen days.*

* Although the operation of tying the superior thyroideal artery was unsuccessful in Sir W Blizard's case, it has been performed since that time by Walther, Coates, Wedemeyer, and others, with success. Walther, in a work entitled, "*Neue Heilart des Kropfes durch die Unterbindung der obern Schilddrusen Schlagadern, &c. Sulzbach*, 1817," has given, perhaps, the best directions respecting this operation: "About half an inch below the origin of the superior thyroideal artery from the external carotid or the common trunk, the omo-hyoideus muscle is seen running over it. This muscle, in cases of enlargement of the thyroid gland is thrown upwards and unnaturally put on the stretch. The putting of this muscle on the stretch may account in part for the difficulty of swallowing, in persons affected with struma. It is easier to tie the artery during its course between this muscle and its entrance into the substance of the gland, than between this muscle and its origin. If the muscle were a great impediment to the operation, it might be divided without hesitation; no apprehension need be entertained about the larger cervical nerves. The sympathetic, parvagum, and the recurrent, are also at a sufficient distance from the seat of the operation to be endangered. That branch of the glosso-pharyngeal nerve might be wounded, which descends on the external border of the thyroid gland, and divides at its superior angle usually into two branches, and below the branch sent by the superior thyroid to the under surface of the sterno-cleido mastoideus. This nerve lies close to the superior thyroid, touches the curve which this artery in its tortuous course makes, and might be very easily wounded. The nerve should, therefore, be drawn to one side, and separated from the artery. The sterno-hyoidei and thyroidei muscles, which cover the lower third of this artery, will not be injured, as they lie so much to the inner side; but it will be scarcely possible to avoid wounding a considerable number of veins. About four lines from the origin of the artery, crossing it at nearly right angles, a branch from the thyroideal veins is situated, which communicates with the facial. This is likely to be divided; it will be easier to avoid it if the artery be tied between that vein and its division, than its origin and division."

"The situation of the superior thyroideal veins is very uncertain; sometimes they are close to the artery, but a little below it, in which case they might be very easily wounded; they not unfrequently run much deeper, at the distance of an inch from the artery. In any case the origin of the superior thyroideal artery from the carotid is higher than that of the veins. These should be avoided with the greatest possible care, since on this depends the undisturbed return of venous blood from the gland. If this be impeded,

The *inferior thyroideal artery* comes from the subclavian; at first, it mounts vertically upon the anterior scalenus, and, having reached the level of the fifth vertebra, it makes a sudden turn inwards; it then passes transversely behind the common carotid, following the same course as the omo-hyoideus, and arrives at the inferior and external part of the thyroid gland, after having given off the ascending cervical artery and a few twigs. It then divides into two large branches, which pass behind the gland, and anastomose with the superior thyroid arteries, and the inferior of the opposite side. To tie this vessel, always proportionally larger in infants than in adults, we ought to divide the integuments along the anterior edge of the sterno-cleido mastoid muscle; and push to one side the cellulo-aponeurotic sheath which incloses the carotid; we then seek for the inferior thyroid artery, a little under and behind the omo-hyoid muscle. Sometimes, but very rarely, this vessel is altogether wanting on one side, whilst, on the other side, especially the right, we find, in place of the two arteries, one common trunk, which springs either from the subclavian or the aorta. Both of these arteries have also been seen arising from the arch of the aorta, between the left carotid and the innominata.

In general, the thyroid gland only receives the four arteries that we have mentioned; but it occasionally happens, that we find another which arises from the sub-clavian, the arch of the aorta, from the innominata, or the common carotid, and which mounts vertically on the anterior surface of the trachea, to pass to the middle of the thyroid gland. In a case, mentioned by Meckel, this vessel arose on the right side, and then

the surgeon can scarcely expect any important diminution in the size of the gland. The situation of the laryngeal branch of the superior thyroideal artery must also be borne in mind; and I conceive it advisable to apply the ligature, if convenient, on the artery, after it has given off this branch."†—T.

† {Professor H. G. Jameson, of Baltimore, in 1821, tied the superior thyroid artery in a case of goitre; the patient was considerably relieved. An account of the case is published in the Am. Med. Recorder, for 1822.—W.}

passed obliquely before the trachea, to be distributed to the left lobe.

§ 80. The veins of the thyroid gland form four principal trunks, the superior of which passes between the sterno-hyoid and sterno-thyroid muscles; and, after having received the laryngeal vein, and often the ranine and the lingual, divide into two branches, which open into the internal jugular. The inferior thyroideal anastomose by an arch in front of the trachea, and form, together with the superior, a plexus, from which a trunk is given off that runs first transversely outwards, then obliquely across the trachea, on the pneumo-gastric nerve and common carotid artery, and opens into the left subclavian vein.

From the anatomical relations which we have described, it is evident that the extirpation of the thyroid gland must be a very serious operation. It has, however, been performed several times with success;* and it even appears, that if the arterial trunks by which it is supplied, together with the principal veins, be first tied, that most of the accidents chiefly to be dreaded will be avoided.

In the operation of bronchotomy, as performed by Raw, Heister, Pelletan, &c. three or four rings of the trachea are divided on the median line, between the sternum and inferior edge of the thyroid gland. But the veins which we have just mentioned run in this spot, and when they are opened, the blood not only impedes the operator, but the muscles and fascia which cover these vessels, prevent it from escaping by the external wound, and from this cause flows into the trachea: it therefore becomes necessary to tie these vessels. Another precaution, not less essential for the success of this operation, is to ascertain with the finger, before the cellular tissue which covers the sterno-hyoid

* The thyroid gland has been removed six times by Hedenus, of Dresden, and three times by Graefe, of Berlin, with success. The number of vessels requiring to be tied in these operations is always very considerable: in one of the cases just alluded to, more than sixty ligatures were used, and in another more than fifty. Vid. Hedenus de glandulâ thyreoidea tam sanâ quam morbosâ.—*T.*

muscle be divided, if the inferior median thyroid artery exists. The advice to cut the rings of the trachea from below upwards, is given, because if the knife were pushed a little too far in the opposite direction, it would open the right carotid artery, or the left subclavian vein.

§ 81. On the side of the trachea, and under the sterno-mastoid muscle, we find a cellulo-aponeurotic sheath, which encloses the *common carotid artery*, the internal jugular vein, and the pneumo-gastric nerve.

The origin of the two common carotids is not alike: the left arises immediately from the arch of the aorta, while the right springs from the innominata; the first is also a little longer than the second. These two vessels are separated by the trachea, and mount a little obliquely outward and backward, as far as the level of the upper part of the larynx. The right carotid, near its origin, is placed a little before the left; it is also more exposed to be wounded in bronchotomy. It is sometimes found a little before the trachea: cases have even been seen in which the two carotids have arisen from a common trunk, and have crossed before this tube, an anomaly which would render bronchotomy very dangerous. In their course, the two carotids are placed on the same transverse line, and are continued directly upwards, till they reach the superior part of the larynx, where they divide. In this course, they are first placed deeply behind the internal surface of the sterno-mastoid muscles, the posterior edge of the sterno-hyoid, and omo-hyoid, which cross their direction. Above the point of decussation of the sterno-mastoid and omo-hyoid muscles (see § 76 and § 67), the carotids become more superficial, and are then only covered by cellular tissue, the fascia, the platysma, and the common integuments. To discover the exact situation of the common carotids at this point, according to Burns, it is, in general, sufficient to draw a line from the point which we have mentioned to the angle of the jaw.

Behind, these vessels rest on the inferior thyroid arteries, longi colli and recti anteriores colli muscles. Inwards they are close on the trachea, the thyroid

gland, the larynx. and the œsophagus. Laterally, they are in contact with the internal jugular veins, the pneumo-gastric, and great sympathetic nerves.

At the superior part of the larynx, the common carotid bifurcates into the external and internal carotids. In some rare cases, this division has been found to occur much lower: Burns once met with it on a level with the sixth cervical vertebra, at about three inches under the angle of the jaw. Sometimes the division only occurs at the last point, or even opposite the upper extremity of the styloid process. Observation has shown that aneurism of the carotid, in general, forms at the bifurcation, and it is the compression which these tumours produce on the larynx and pharynx, that causes these affections to be sometimes accompanied with so great a difficulty of respiration, and deglutition.

The *external carotid artery* mounts vertically under the platysma, passes beneath the hypo-glossal nerve, and the posterior belly of the digastric and the stylo-hyoid muscles, and runs a little outwards and backwards, and sinks under the parotid gland (§ 54). In this course it gives off, anteriorly, the superior thyroid arteries, the facial, and the lingual; posteriorly, the occipital and auricular, and internally, the inferior pharyngeal.

The *internal carotid*; placed first by the side of the external, but somewhat more superficially, mounts afterwards behind it; it then recedes from it behind the digastric muscle, and runs inwards and backwards, till it reaches the foramen caroticum (see § 54). The internal jugular vein lies on its anterior and outer side, the eighth pair on the outer and back part, and the vertebral column behind.

§ 82. The *internal jugular vein*, after leaving the cranium by the foramen lacerum posterius, descends behind the styloid process and the muscles which are attached to it, communicates with the external jugular by a pretty large trunk, receives the facial, lingual, pharyngeal, superior thyroid, and occipital veins, and, having arrived at the upper edge of the thyroid cartilage, it descends external to the common carotid artery and the eighth pair, and terminates in the subclavian.

The *pneumo-gastric nerve*, or the eighth pair, which leaves the cranium by the same foramen with the internal jugular vein, is placed upon the recti ant. capitis and the longus colli muscles, to the outside of the carotid artery, and behind the vessel which we have just named.* In this course, it gives off the pharyngeal and superior laryngeal nerves. At the inferior part of the neck, it glides behind the subclavian vein, and enters the chest; it then gives off the *inferior laryngeal* or *recurrent* nerve, which winds round the subclavian artery of the right side, and the aorta on the left side; it afterwards ascends behind the common carotid and the inferior thyroid arteries, in the space which separates the trachea from the œsophagus, and gains the inferior part of the larynx to which it is distributed.

Along the anterior side of the internal jugular vein, we find the ascending cervical branch of the *hypo-glossal nerve*. This branch, which is given off at the point where the nerve winds round the digastric muscle (see § 72), descends as far as the middle of the neck, bends backwards and upwards to anastomose with the internal descending branch of the cervical plexus, and forms an arch under the sterno-mastoid muscle, and upon the common carotid artery and the internal jugular vein.

There is, perhaps, no operation in which an exact knowledge of the relative situations of the parts interested is of higher consequence, than in that for tying the common carotid artery: in fact, the size of this artery, the importance of the nerves which surround it, and the closeness of the internal jugular vein, to which it is united by a cellular membrane, all augment the diffi-

* {The common carotid artery, internal jugular vein, and par vagum, or pneumo-gastric nerve, are enveloped in a common sheath formed from the fascia superficialis. It will be observed also on a careful examination, that a distinct layer of fascia proceeds forwards in such a manner as to form a complete sheath for the carotid artery, and another which contains the internal jugular vein, and par vagum nerve.—A knowledge of this fact is of some practical importance, as in the operation of tying the carotid artery we should in consequence be induced to open the sheath on its inner side, and also to pass our needle from without, inwards, so as to avoid the possibility of including the nerve within our ligature.—W.}

culty and danger of the operation. It is not a matter of indifference in what part of the neck the operation be performed: above the point of decussation of the sterno-mastoid and omo-hyoid muscles, the artery is very easily laid bare; but it unfortunately happens that, in general, the aneurismal tumour, for which the operation is required, is situated so low, that the surgeon is obliged to tie the artery lower down. Instead of only having the skin, the platysma and the fascia to divide, it then becomes necessary to detach and turn back the anterior edge of the sterno-mastoid muscle, which covers the carotid at the inferior part of the neck, and sometimes even to turn aside the sterno-hyoid muscle, before we can discover the cellular sheath which surrounds the artery. In all cases, the integuments are divided parallel to the anterior edge of the sterno-mastoid, and after having laid bare the sheath which we have just mentioned, it is necessary to open it with caution, which is sometimes rather difficult. The artery must then be separated, to a certain extent, from the surrounding parts.

In the efforts of inspiration and expiration which the patient makes, the internal jugular vein swells and becomes flaccid, and almost empty, alternately: it is, therefore, proper to direct an assistant to compress this vessel, by placing his finger above the upper extremity of the incision, so as to impede the passage of the blood, and to produce the sinking down of the vein; for, while it swells, it in a great measure covers the artery, and embarrasses the operator.* The pneumo-gastric nerve is not so intimately connected with the artery, as with the vein under which it is placed, so that, to avoid including it in the ligature, it is sufficient to introduce the needle betwixt it and the artery: on the contrary, if we introduce that instrument on the internal side of

* {Sir Astley Cooper, who first performed the operation of tying the carotid artery for the cure of aneurism, was the first to notice this circumstance. The operation has since been very frequently performed, and in most of the cases published, we find no allusion to this occurrence; whilst others state, that it presented no such impediment as they were led to expect from the account given by Sir A. Cooper.—W.}

these vessels, it would be very difficult to avoid including the nerve in the ligature. It is also necessary carefully to avoid wounding the recurrent nerve, which we have seen running between the internal side of the common carotid and the trachea. Lastly, when this operation is performed, entirely at the base of the neck, it is necessary to recollect that the thoracic duct is lodged immediately behind the left carotid, betwixt the sheath of this vessel and the great sympathetic nerve, and that, in some individuals, it mounts a considerable way up the neck before it bends downwards and outwards, to reach the subclavian vein. To avoid including this duct, the operator must be careful to maintain the point of the needle, as exactly as possible, in contact with the sides of the artery.

The anastomoses by which the carotids communicate together, and with the vertebral arteries, are so numerous and so direct, that when one of these vessels is tied, the circulation, both within and without the cranium, does not appear to suffer the slightest derangement. In fact, after this operation, little derangement of the brain manifests itself; for even, on throwing a coarse injection into one of the carotids, or the subclavian, we see it pass into all the arteries of the opposite side of the head. Physiologists have also repeatedly tied the two common carotids at the same time in living animals, without the functions of the brain appearing to suffer the slightest interruption.

§ 83. The cellular aponeurotic sheath which surrounds the common carotid artery, the internal jugular vein, and the eighth pair, also incloses a considerable number of lymphatic glands. When these bodies are enlarged, it is sometimes very difficult to distinguish them from an aneurism of the carotid; for if they are situated before the artery, a pulsating feel is communicated to the tumour. Behind this sheath we find the *filament of communication of the cervical ganglia.* This nervous cord, whose size varies very much, arises from the upper cervical ganglion, descends vertically before the rectus major anterior capitis and the longus colli, and is united by loose cellular tissue to the sheath of the large vessels we have mentioned. On a level with the

fifth or sixth vertebra, it communicates with the middle cervical ganglion, of which both the size and form greatly vary, and which is entirely wanting in many subjects. Below this point, the filament of communication continues its course, as in the upper part of the neck, and reaches the inferior cervical ganglion, which is situated between the transverse process of the seventh cervical vertebra, and the neck of the first rib.

We also find behind the sheath of the large vessels of the neck the *superior cardiac nerves*, which arise from the upper cervical ganglion, and from its branch of communication with the middle, as also from this last, and anastomose with the branches of the eighth pair, and with the hypo-glossal, and proceed towards the inferior and anterior part of the neck, to penetrate into the chest near the trunk of the aorta.

§ 84. The internal jugular vein, as we have already mentioned, opens into the subclavian at the inferior part of the neck, behind the sterno-mastoid muscle, and contributes to form the trunk of the superior vena cava, which commences at the level of the cartilage of the first rib. The *subclavian vein* is the continuation of the axillary, and takes this name in front of the inferior extremity of the scalenus anticus muscle: it first runs transversely from without inwards, and then bends downwards, to enter into the chest. That of the left side is very short, and is covered by the clavicle, the subclavian, and sterno-mastoid muscles, the sterno-clavicular articulation, the cartilage of the first rib, and a small part of the sternum; its posterior surface is in contact with the anterior scalenus muscle, the right subclavian artery, and the mediastinum. The right subclavian vein is much longer, and runs more in a horizontal direction; it is covered by the same parts as the vein of the opposite side, and, besides, by the greater part of the breadth of the sternum, and by the muscles which are fixed to that bone. It also covers the same parts as the left, as well as the arch of the aorta and the arteria innominata.

§ 85. The *anterior scalenus muscle*, on the external surface of which the subclavian vein lies, is large, flat,

and of a pyramidal form, situated at the lateral and inferior part of the neck. It is fixed by its base to the middle of the external surface, and to the superior edge of the first rib, which at this point has a projecting tubercle: it mounts a little obliquely inwards and backwards, and is inserted, by means of four little tendons, into the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ. The anterior surface of this muscle is covered by the subclavian vein, the transverse and ascending cervical arteries, the phrenic or diaphragmatic nerve, and the omo-hyoid and sterno-mastoid muscles. Its posterior surface is separated from the scalenus posticus muscle by a triangular space, where the subclavian artery, and the branches of the nerves that form the brachial plexus, are lodged.

§ 86. The *ascending branch of the inferior thyroid artery* (§ 79) arises from the external side of this vessel, mounts on the external surface of the anterior scalenus muscle, then on the longus colli, to the upper part of the neck, where it sends off branches to the neighbouring soft parts, and anastomoses with the vertebral, posterior, cervical, and occipital arteries. The inferior thyroid also frequently gives off the transverse cervical and the superior scapulary arteries, though these vessels sometimes arise from the subclavian. In all cases the transverse cervical, situated first at the side of the anterior edge of the scalenus muscle, and a little behind it, winds round this muscle above the nerves which form the brachial plexus, and runs transversely, outwards and backwards, to sink under the trapezius muscle. In this course it is covered by the sterno-mastoid and platysma. The *superior scapulary artery* passes between the sterno-mastoid and the anterior scalenus, and runs outwards, in a tortuous course, towards the upper edge of the scapula, behind and under the clavicle: it often runs in the direction of this last bone; at other times it is placed much higher.

§ 87. The *subclavian artery* presents some important differences, according as it is situated on the right or left side of the neck. This vessel, as also the carotid, arises on the right side from the innominata, by the side of the trachea, whilst on the left it springs directly

from the aorta. The *arteria innominata* arises from the arch of the aorta, some lines from the origin of the left carotid, and runs from below upwards, from the left to the right side, along the trachea, and in front of the longus colli: it is separated from the sternum by the sterno-thyroid muscle, and by the left subclavian artery, which runs beside it; lastly, it is about an inch long; sometimes, however, it is two inches, and it then ascends nearly to the lower edge of the thyroid gland. In certain cases of aneurism of the right subclavian artery, it has been proposed to tie the arteria innominata. If we throw the head backwards, and divide the sternal portions of the sterno-mastoid, as also those of the sterno-hyoid and sterno-thyroid muscles, it is not difficult, in the dead body, to follow the course of the artery to the point where it arises from the innominata, and to pass a ligature under this vessel at the bottom of the neck, for in this position it is drawn upwards. But, as Hodgson observes, it would be impossible for a patient to continue in this position during a painful operation. This difficult operation has, however, been performed by Mott, professor of surgery at New-York, P. Graefe of Berlin, and Mr. Norman of Bath.

The right subclavian artery, after it separates from the innominata, runs obliquely outwards under the clavicle, the sterno-hyoid, and sterno-thyroid muscles, the subclavian vein and the pneumo-gastric and diaphragmatic nerves, and between the scaleni muscles. The left subclavian artery arises from the arch of the aorta, and is deeper placed than the right; it rises vertically towards the scaleni, and suddenly bends to pass between them. In this course, it is first covered by the lung and the subclavian vein, then by the eighth pair, which runs parallel to it, instead of crossing it, as in the opposite side of the neck; it is afterwards placed under the clavicle and the sterno-thyroid muscle. Its posterior surface rests upon the longus colli and the vertebral column, whilst the right subclavian is separated from these parts by an interval sufficiently well marked: both are connected with the inferior cervical ganglion and the recurrent nerve; lastly, the inner side of the left subclavian lies close on the carotid,

whilst there is a triangular space between these vessels on the right side.

The subclavian arteries, in general, run a considerable way without giving off any branch; sometimes, however, they send off close to their origin pretty large branches, that run to the thymus gland and neighbouring parts. Near the first rib, before passing between the scaleni, these vessels give off several large branches, which are generally distinguished into superior or posterior, and into inferior or anterior ones. The vertebral and inferior thyroid (see § 79) are the most constant of the first class; sometimes the transverse cervical, superior scapular, the ascending cervical, and the deep cervical, also arise from this portion of the subclavian.

The *vertebral artery* runs directly from below upwards, between the anterior scalenus and the longus colli, and behind the inferior thyroid artery, as far as the base of the transverse process of the sixth cervical vertebra, when it enters into a kind of canal, formed by the holes in the transverse processes of the cervical vertebræ. Sometimes the artery of the left side arises immediately from the arch of the aorta, between the carotid and the subclavian; but on the right side this anomaly is very rare. At other times, in place of entering into the hole of the sixth or seventh vertebra, it only enters at that of the fifth, fourth, third, or even the second vertebra. In these rare cases, in general, it runs immediately behind the sheath of the carotid artery, and on the anterior surface of the rectus anterior capitis. The knowledge of the possibility of such an anomaly existing is important in practice; for if, in a case of this kind, this vessel should become affected with aneurism, we might easily be led into error on the seat of the tumour, and believe that it was situated in the carotid. It is for this reason, that when we tie the carotid for aneurism, Burns advises us to compress the vessel between the fingers and thumb, before opening the sheath, to ascertain if the compression of the carotid causes the pulsations in the tumour to cease.

The inferior branches of the subclavian are, the *internal mammary*, and the superior intercostal. The first of

these vessels, in general, arises from the anterior and inferior side of the subclavian, nearly before the inferior thyroid, and descends almost in a straight line, close to the sternum, behind the cartilages of the ribs. The *superior intercostal* separates from the subclavian a little farther outward than the preceding, and runs downwards and outwards; it passes upon the neck of the first rib, and is distributed to the sides of the chest.

The subclavian artery, after entering behind the anterior scalenus, rests on the groove of the first rib, and is placed before the posterior scalenus; at the external edge of this muscle it runs obliquely outwards and downwards, and passes under the clavicle. In this course, the artery rests on the superior surface of the first rib (on which it produces a depression more or less marked), on the intercostal space, and then on the second rib; it is in contact with the subclavian vein on its anterior surface, and with the brachial plexus at its posterior and internal side.

We can tie the subclavian artery before it passes between the scaleni muscles, or after it has passed their external edge. The first of these, which is always a very serious operation, may be performed in several different ways.* Hodgson advises us to make a horizontal incision of the skin and platysma, immediately above the sternal extremity of the clavicle, to divide the insertion of the sterno-mastoid into the clavicle, to separate with the finger the cellular tissue which fills up the bottom of the wound, until we reach the anterior scalenus, and then to lay the artery bare on the tracheal edge of this muscle. We then put the ligature on this vessel, very near the origin of the vertebral and inferior thyroid arteries, but it is necessary to be careful in passing the needle not to tear the pleura, on which it is placed. M. Marjolin thinks it better to make two incisions, which, when joined, have the figure of the letter T reversed, the vertical branch of

* {It has been proposed by Dupuytren, when the tumour extends high up, to cut across the scalenus anticus muscle, and in this situation to pass our ligature around the subclavian artery, at a point where it gives off no branches, and after all its principal branches have been sent off.—W.}

which will run along the external edge of the sterno-mastoid muscle. This surgeon also recommends lowering the patient's shoulder, by an assistant, during the operation, and to pass the needle between the artery and the vein. In performing this difficult and dangerous operation, he says that it is necessary to be very cautious not to wound the subclavian, the internal jugular and inferior thyroid veins, the pneumogastric and diaphragmatic nerves, or the arterial branches arising from the trunk we wish to tie. On the left side, it is necessary to be peculiarly circumspect, to avoid wounding the pleura, or tying the thoracic duct, which, making a curve outwards, descends on the scalenus, to reach the posterior part of the angle formed by the subclavian and internal jugular veins. Finally, another circumstance, which is very much against the success of the operation, and which depends on the anatomical relations that we have already described, is the necessity of placing the ligature at a point where a collateral branch may arise, a circumstance that makes the surgeon apprehensive of secondary hæmorrhage.

It is less difficult to tie the subclavian after it has passed between the scaleni. In this operation we have as guides the external edge of the anterior scalenus, and the tubercle of the first rib, over which the artery passes, and which may always be felt with the finger; in fact, the artery is always placed behind the first, and external to the last, and lies in a triangular space formed by this muscle, the omo-hyoid and the clavicle, and, when we have divided the integuments and the platysma, we find this vessel simply covered by loose cellular tissue. The cervical nerves are placed so near the subclavian artery, where it passes over the first rib, that it often communicates a pulsatory motion to them; in consequence of this, surgeons have been known to put the ligature around these cords, supposing they had merely included the artery. Lastly, although this may be a tolerably easy operation on the dead body, when there is no tumour under the clavicle, it is not the same in the living subject; for when an aneurism of the axillary artery of considerable size exists, it raises the clavicle, and the artery becomes so deeply placed

behind this bone, that it is often difficult to pass a ligature around it.

While the subclavian artery runs on the external surface of the first rib, which presents a plane, inclined from above downwards, and from within outwards, we can compress it by pressing with the thumb from below upwards, and from behind forwards; but it is chiefly when the shoulder is forcibly depressed, that we are able by this means completely to efface the caliber of the artery.

§ 88. The greater part of the space which exists between the scaleni muscles is occupied externally by the nerves that form the *brachial plexus*. This plexus is formed by the re-union and interlacement of the anterior branches of the four lower cervical nerves and the first dorsal, which unite into three distinct cords, and terminate by being completely intermixed at the level of the first rib. These nerves are in general all placed at the outside of the subclavian artery; sometimes, however, one of them is found behind, before, or at the internal side of the artery. The anterior branches of the four superior cervical nerves also give off branches, which, by their anastomosis with the neighbouring nerves, form the *cervical plexus*, which is placed along the corresponding vertebræ, under the sterno-mastoid, and to the outer side of the internal jugular vein, the carotid artery, the pneumo-gastric nerve, and upon the posterior scalenus. This plexus gives off several subcutaneous branches, that are distributed to the different parts of the neck; and the diaphragmatic nerve, which arises from its inferior extremity, descends on the lateral part of the neck between the rectus anterior capitis, and the scalenus, and enters the chest between the artery and the subclavian vein.

The *posterior scalenus* muscle, on which the parts we have mentioned rest, is longer and thicker than the anterior; its inferior extremity is fixed to the external surface of the first rib, at a rough depression, which may be seen behind the passage of the subclavian artery, and to the upper edge of the second rib; it is attached by its superior extremity to the last six transverse cervical processes.

§ 89. Internal to the carotid arteries, behind the larynx, and immediately before the vertebral column, the œsophagus, and the *pharynx*, are found. The pharynx extends from the base of the cranium as far as the middle of the neck; it is narrow superiorly, more enlarged at the middle, and contracted again inferiorly. The summit of this muscular membranous canal is united by cellular tissue, and by the muscles which we shall presently notice, to the basilar process of the occipital bone, and to the petrous portion of the temporal. We see at its anterior part the posterior openings of the nasal fossæ, the posterior surface of the velum palati, the posterior opening of the mouth, the base of the tongue, the aperture of the epiglottis, and lastly, the posterior surface of the larynx. The inferior openings of the nasal fossæ are oblong from above downwards, and separated from each other by the partition of the fossæ; lastly, their superior and inferior walls are inclined downwards in such a manner as only to form an obtuse angle with those of the pharynx.

The posterior surface of the velum palati is smooth and inclined downwards and backwards; the pharyngeal aperture of the mouth, or the isthmus of the œsophagus, is equally oblique, but in an opposite direction; for the inferior edge of the velum, which constitutes its superior edge, is situated about an inch and a half behind the arch of the palate, whilst the base of the tongue, which forms its inferior boundary, is placed more forwards, and is inclined from above downwards and from before backwards. Under these different parts we find the larynx, the opening of the glottis, and the epiglottis, a kind of sucker, which in descending covers the entrance of the larynx. It is a fibro-cartilaginous body, of an oval form, the large extremity of which is free, the small or anterior one being attached by ligamentous fibres to a notch on the edge of the thyroid cartilage. Its superior or lingual surface, concave from above downwards, convex transversely, is covered by the mucous membrane of the mouth, and is united below to the os hyoides and the base of the tongue.

In the ordinary state the epiglottis is almost vertical; but in deglutition it becomes horizontal, and then co-

vers the aperture of the larynx. In cases of asphyxia, when we endeavour to introduce a sound into the trachea to perform artificial respiration, it is necessary to recollect the situation of the epiglottis; in fact, this kind of sucker is placed so deeply, and descends so easily on the larynx, that it will be very difficult to pass an instrument, if we introduce it by the mouth, between the edges of the glottis. To render this operation practicable, it is necessary to begin by carrying the finger as far as the epiglottis, to retain it upon the back of the tongue, whilst we pass the sound, which in general is almost impossible. But the same difficulties are not met with when we adopt the plan of Desault, and endeavour to introduce the tube by the nostrils. In fact, the base of the epiglottis being farther forward than the inferior edge of the velum palati, it then becomes easy to direct the instrument behind the epiglottis, and to pass it into the larynx. If the head, however, were placed horizontally on the vertebral column, or if the tongue fell to the bottom of the mouth, the instrument would still strike against the epiglottis, and would glide behind the larynx into the œsophagus; hence in this operation it is necessary to turn the head back, and to draw the tongue outwards, or at least to depress the posterior part of it. Another direction, which it is equally necessary to recollect in the operation, is to push the larynx gently backwards against the vertebræ, when the point of the tube has arrived near the base of the tongue; for, by this means, we compress the opening of the œsophagus between the cricoid-cartilage and the vertebræ; and we carry the opening of the glottis before the instrument we wish to introduce.

The external wall of the pharynx has, at its superior and anterior part, the pharyngeal openings of the Eustachian tubes, canals which establish a communication between the posterior fauces and the cavity of the tympanum. This opening is placed some lines behind the middle meatus, and at the top of a slight depression formed by the circumflexus palati, the pterygoid process, and the levator palati. It is directed forwards, and a little downwards, and the fold that the pituitary

membrane makes at the inferior turbinated bone, terminates at its upper part. Behind and a little above the opening of the tubes, we see a somewhat deep groove, that corresponds to the space left between the pharyngo-palatinus and superior constrictor muscles of the pharynx, and which terminate superiorly by a kind of semi-circular fold, that sometimes forms a sort of cul-de-sac. As Rosenmuller observes, it is essential to recollect this circumstance when we wish to throw injections into the Eustachian tube, or else the point of the instrument will be readily caught in this sort of cul-de-sac, instead of passing into the mouth of the tube. To perform this operation, we slide a canula, the extremity of which is properly curved, along the inferior meatus. When we direct the convex side of the instrument upwards to pass it into the nostrils, it is necessary, as soon as it has reached the posterior extremity of the meatus, to give it a slight rotatory motion, by means of which its extremity turns upwards and outwards towards the orifice of the tube, into which we introduce it with a very slight force. When, on the contrary, we introduce the sound first directing its convexity upwards, it is afterwards necessary to turn it a little outwards. The external side of the pharynx presents nothing particular in the rest of its extent. It is the same with the posterior side, which is slightly flattened.

The mucous membrane which lines the pharynx is continuous with that which covers the nasal fossæ, the mouth, the Eustachian tube, the larynx, and the œsophagus. It is smooth, free from villosities, and of a well-marked red colour; its follicles are ovoid, pretty large, and more abundant superiorly than below. Under this membrane we find the muscular layer of the pharynx: it is formed by the superior, middle and inferior constrictor muscles, the stylo-pharyngeus, palato-pharyngeus; and posteriorly it is connected to the vertebral column, the recti anteriores capitis along the neck, and laterally with the internal carotids, the internal jugular veins, the pneumo-gastric and hypo-glossal nerves, &c.

§ 90. The inferior extremity of the pharynx is continuous with the œsophagus, a musculo-membranaceous

tube, which extends from the level of the fifth cervical vertebra to the superior orifice of the stomach, between the pillars of the diaphragm. It is formed of a membranous and muscular layer, like the pharynx: at the point where it unites with the pharynx, that it is at the level of the cricoid cartilage, it has a well-marked contraction, which might lead a surgeon, ignorant of this peculiarity, into error, when he attempted to sound this canal: in fact, he might attribute the resistance which he met with here to a stricture. The œsophagus is first placed on the median line of the neck, but below the larynx it runs a little to the left, and descends in the same direction till it enters the chest. It is connected before to the larynx, the left lobe of the thyroid gland, and the left half of the trachea, the inferior thyroid vessels of the same side, the course of which it crosses, and the sterno-thyroid muscle; behind with the cervical vertebræ and longus colli; and laterally, first with the carotid arteries and the internal jugular veins, then on the right with the trachea, and on the left with the recurrent nerve and the carotid. It is on account of this deviation of the œsophagus to the left side that we have been advised to open this side of the neck in œsophagotomy; but, as Boyer observes, the operation should only be performed in the case of a foreign body sticking in the œsophagus, which makes a projection externally, and the incision ought to be made on it. To reach the œsophagus, it is necessary to divide the skin, the fasciæ of the neck, the platysma, and the cellular tissue along the trachea, between the external edge of the sterno-hyoid and sterno-thyroid muscles, and the inferior edge of the omo-hyoid; the incision ought to be bounded before by the trachea and the recurrent nerve; outwards by the carotid artery and the internal jugular vein; above by the superior thyroid vessels, and below by the inferior; it is also necessary to proceed with the greatest circumspection, in order to avoid wounding these important parts.

There are two ways of introducing tubes into the œsophagus, by the mouth or by the nostrils. The first of these is more direct, and merits the preference when we do not wish the instrument to remain in: to

introduce a sound in this way, all that is required is to turn the head back, depress the base of the tongue with the index finger, and carry the instrument along the radial edge of the finger as far as the posterior side of the pharynx, on which it bends and slips into the œsophagus.* When we introduce the tube by the nostrils, we risk carrying it into the larynx instead of the œsophagus, if we are not careful to place the head in a horizontal direction with regard to the vertebral column, and direct the patient not to thrust the tongue out; for the epiglottis is then drawn upwards, and leaves the aperture of the glottis open.

§ 91. Behind the œsophagus we find the vertebral column and the muscles that cover its anterior surface; but, as these different parts do not interest the surgeon, we shall not describe them here.

CHAPTER VI.

POSTERIOR CERVICAL REGION.

§ 92. The posterior cervical region constitutes what is properly called the nucha, although by this term we in general designate more immediately its upper part. It is bounded above by the upper region of the head, and laterally by the line which extends from the posterior edge of the mastoid process to the scapular extremity of the clavicle, and which separates it from the anterior cervical region. Below it terminates without any very well-marked division, in the superior part of

* {If, when the point of the tube is introduced into the mouth, we direct the patient to make an effort at swallowing, (when that is practicable,) and at the same moment thrust forward the tube, it will very readily pass into the œsophagus. In this place, we might call attention to the valuable instrument invented by Dr. C. B. Matthews of Philadelphia, for evacuating the stomach in cases of poisoning, which may be procured of Mr. John Rorer of this city.—W.}

the back and shoulders: we also include in its description all the parts situated above the level of the superior edge of the scapula. We observe, at the upper part of this region, a slight depression on the median line, between the projection formed by the external muscles of the head, which, however, is effaced when these parts are bent; lower down we see a projection formed by the seventh cervical vertebræ; finally, it is rounded on the sides, and presents nothing remarkable.

§ 93. The skin which covers this part of the neck is thicker, and not so white as that of the anterior cervical region; above it is covered with hair, and presents all the characters proper to the integuments of the cranium. In general it is free from wrinkles, not very yielding, and strongly adherent to the subjacent parts. The cellular tissue which it covers is laminated, dense, and compact: it is closely united to the integuments, but adheres only slightly to the fascia beneath; so that, when we raise the skin to place a seton in it, it is always included in the fold formed. The most convenient place for putting in a seton, is the middle of this region, not merely from the facility with which the skin can be pinched up, but also on account of the bandages being less apt to slide more than in any other part; however, when patients are not willing to consent to it on account of the cicatrix that it causes, we may introduce the seton in the hairy part of the neck. In such a case it is often impossible to raise the integuments so as to form a suitable fold, and we are obliged to slide the needle between them to the whole extent required.

On the sides of the neck, the deep fascia forms no more than an indistinct, laminated layer; at the edge of the trapezius muscle it separates to surround it, and terminates on the median line, when it is continuous with the *superficial cervical ligament*. This ligament is a narrow, and very long fibrous cord, which it is often difficult to distinguish from the aponeurosis of the trapezius. It begins at the spinous process of the seventh cervical vertebra, and is fixed to the external occipital protuberance and to the superior curved line, ascend-

ing between the trapezius splenius, and complexus muscles; anteriorly it is prolonged in the form of a cellular layer, which runs as far as the external occipital crest, and is continuous with the inter-spinous ligaments.

§ 94. *The trapezius muscle*, which forms the first muscular layer of this region, extends from the upper part of the back, and is fixed by means of intermediate aponeurotic layers, to the internal third of the superior occipital ridge, to the ligamentum nuchæ, to the spinous process of the seventh cervical vertebra, and to all those of the back, and to the inter-spinous ligaments that unite them.* The fibres arising from these different points, run in a converging direction to the shoulder, where they are inserted into the scapular extremity of the clavicle, the acromion, the acromio-clavicular ligament, and the spine of the scapula. The internal surface of this muscle is in contact with the complexus, splenius, levator scapulæ, the serratus posticus superior, supra and infra-spinati, and rhomboidei muscles, and a pretty large branch of the *transverse cervical artery*, (see § 86.)

The *splenius muscle*, placed obliquely at the inferior part of the neck and upper part of the back, is long, flattened, and smaller below than above, where it is divided into two portions that are inserted into the points of the transverse processes of the two first cervical vertebræ, to the mastoid process and to the occiput,

* {In his highly interesting work, entitled "Anatomical Investigations," Professor J. D. Godman, gives the following description of a vein, for which, from its peculiar character, he has proposed the name of azygos dorsalis. "This vein lies immediately under the integuments of the back, and emerges at a short distance above the origin of the trapezius muscle. It ascends external to the trapezius as a distinct trunk, receiving branches from both parts of the muscle until it has risen as high as between the third and fourth dorsal vertebræ. Then it separates into two trunks, which diverge an inch or more from the spine, and penetrate the muscle immediately above the second dorsal vertebra, and empty their blood into the subclavians by means of the deep seated cervical veins. The ordinary veins of the back send their blood more directly to the heart by pouring it at once into the branches of the intercostals terminating in the vena azygos, *interna*."—W.}

between the inferior and superior ridge. The inferior extremity of this muscle is fixed to the lower third of the cervical ligament, to the transverse processes of the seventh vertebra of the neck, and the five first dorsal vertebræ. Its posterior surface is covered superiorly by the sterno-mastoideus, in the middle by the trapezius and levator scapulæ, and below by the serratus posticus superior and the rhomboidei. Its internal edge separates from the median line in ascending to the head, and leaves between it and that of the opposite side a triangular space, in which we see the complexus.

The *levator scapulæ* is a long, thick, and roundish muscle, that arises from the transverse processes of the four first cervical vertebræ, and runs downwards and outwards to reach the upper angle of the scapula. It is in contact with the sterno-mastoid, the skin and the trapezius by its posterior surface, and with the serratus posticus superior, sacro-spinalis and external intercostals, by its anterior surface. The splenius, the rhomboidei, and the serratus, form the second muscular layer; the two last belong more properly to the back, and shall, therefore, only be noticed when describing that part of the trunk.

The *complexus*, along with the trachelo-mastoideus and transversalis, forms the third muscular layer. It is attached inferiorly to the transverse and articular processes of the six last vertebræ of the neck, and to the transverse processes of the four or five superior dorsal vertebræ, and superiorly to the rough space comprised between the two curved lines of the occiput. The posterior surface of this muscle is in contact with the trapezius, complexus, transversalis and longissimus dorsi. The anterior covers a part of the semi-spinalis colli, the deep cervical artery, the posterior branches of the cervical nerves, and the recti and obliqui capitis.

The *trachelo-mastoideus*, placed on the outside of the former, is a slender, long muscle, attached to the transverse processes of the four last cervical vertebræ and the first dorsal, and to the temporal bone behind the mastoid process. It covers the complexus, the obliqui

capitis and the posterior extremity of the digastricus, and the occipital artery.

The *semi-spinalis dorsi*, almost confounded with the preceding, is attached superiorly to the transverse processes of the cervical vertebræ, from the second to the sixth, and inferiorly to the transverse processes of the dorsal vertebræ, from the third as far as the eighth.

§ 95. The *occipital artery*, which is found beneath this muscular layer, arises from the posterior side of the external carotid under the parotid gland, mounts obliquely backwards under the sterno-mastoid and the digastric muscles, the hypo-glossal and pneumo-gastric nerves and the internal jugular vein: it then bends on the occiput, beneath the splenius, and terminates on the integuments at the posterior part of the head. The *deep cervical artery* is given off by the subclavian, behind the anterior scalenus and immediately before the transverse processes: sometimes it is a branch of the inferior thyroid or the vertebral; in either case it ascends obliquely outwards, between the two last transverse cervical processes, then runs backwards, upwards, and inwards, under the complexus, and terminates at the superior part of this region, where it anastomoses with the vertebral and occipital arteries.

§ 96. The fourth muscular layer is formed by a very considerable number of muscles placed between the head and the vertebræ, and between the vertebræ themselves. The muscular bundle, which M. Chaussier calls *sacro-spinal*, and which some authors consider as formed by three distinct muscles, viz. the sacro-lumbar, the longissimus dorsi and the multifidus spinæ, occupies the whole extent of the vertebral groove, and is attached, in the region that we are describing, to the transverse and spinous processes of the vertebræ. The inter-spinales occupy the space between the spinous processes, and are covered externally by the foregoing. The *rectus posticus major*, situated at the upper part of the neck, is flattened and triangular; it is fixed to the spinous processes of the second vertebræ, and mounts outwards and a little backwards, to terminate in a radiated form on the inferior occipital ridge; its poste-

rior surface is in contact with the complexus and obliquus minor. The *rectus p. minor*, placed under the former, and of the same form, is fixed to the centre of the arch of the first cervical vertebræ and to the side of the vertical crest of the occiput. The posterior surface of this muscle is separated from the complexus by fat and cellular tissue. The *obliquus major capitis* is a slender fleshy bundle, fixed to the spinous process of the dentata, near the insertion of the rectus major, and runs backwards, outwards, and upwards, to reach the summit of the transverse process of the atlas. Lastly, the *obliquus minor* is also inserted into the first transverse cervical process, and into the occiput below the external part of the upper curved line.

§ 97. Under the small muscles that we have mentioned, we find the vertebral artery (see § 89) which at the dentation leaves the vertebral canal, runs backwards and makes a vertical curve between the two first vertebræ, and beneath the obliquus minor. This vessel then runs upwards and inwards as far as the transverse process of the atlas, the base of which it traverses, and the obliquus major, and before entering the cranium, forms a second transverse curve between the atlas and the occiput, in the triangular space between the complexus and the rectus posterior capitis.

§ 98. The *sub-occipital nerve* traverses the fibrous canal by which the vertebral artery penetrates the cranium, is placed between this vessel and the posterior arch of the atlas, forms a ganglion there, and divides into two branches; the anterior one runs on the external side of the vertebral artery and passes above the transverse process of the atlas to anastomose by an arch with a twig from the first cervical nerve; the other, somewhat larger, runs backwards, through the fatty cellular tissue that fills the triangular space between the obliqui and the rectus major, and divides into three branches that are distributed to the neighbouring parts.

The posterior branch of the first pair of cervical nerves, bends from below upwards, under the inferior edge of the obliquus major, mounts between this muscle and the complexus, and terminates on the occiput,

frequently becoming subcutaneous. That of the second pair pierces the complexus and trapezius, and becomes subcutaneous near the top of the neck. The posterior branches of the other cervical curves are also distributed to the muscles and teguments; the inferior are considerably larger than those we have noticed; but otherwise they present nothing remarkable. Lastly, we find in this region twigs of the nervus accessorius, which, after traversing the sterno-mastoid, goes under the trapezius, and is there lost.

§ 99. The external occipital protuberance, the superior boundary of the posterior cervical region, is situated on the median line, nearly at an equal distance from the superior angle of the *os occipitis* and from the foramen magnum. It is placed at the top of a crest that extends from the foramen we have mentioned; laterally it is continuous with a curved line that gives attachment to the occipito-frontalis, trapezius and sterno-mastoid, and which is named the upper curved line, to distinguish it from a second transverse crest, equally arched, situated a little lower; we observe, both above and below the last line, rough surfaces for the attachment of the complexus, splenius, recti posteriores and obliquus minor. This portion of the occipital bone corresponds to the inferior occipital fossa that lodges the corresponding lobe of the cerebellum. The thickness of the soft parts has led many surgeons to believe that it would be impossible to trephine here; it appears, however, that their fears are exaggerated. But the upper curved line corresponds with the groove that lodges the lateral sinus of the dura mater; it is therefore necessary to avoid applying the instrument upon it.

§ 100. The portion of the vertebral column placed in this region is the only part capable of executing well-marked movements, and of being luxated without fracture. In fact, the first cervical vertebra has no spinous process, and in the others this osseous projection, being directed almost horizontally backwards, although it becomes more and more elongated, allows the neck to perform very extensive flexion backwards. The spinous processes of the dorsal vertebræ being, on the contrary, strongly inclined downwards, and, we

might say, locked together, this movement is almost impossible in that part of the column. The transverse processes, eminences situated on the sides of the vertebræ, are also very short, especially on the upper part of the neck, and their extremity is free, whilst in the back they are not only longer, but also articulated with the ribs, which further diminishes the extent of lateral flexion of these bones; the base of the transverse cervical processes, as already noticed, has a hole for the passage of the vertebral artery. Lastly, the space between these eminences and the spinous processes is filled by the arch of the vertebræ, and forms a groove for lodging the sacro-spinal muscles.

The articulation of the head with the first vertebra or atlas is a double arthradia, arising from the contact of the condyles of the occiput with the superior articular cavities of the atlas. The solidity of this articulation depends more on the disposition of these parts than the ligaments that unite them; in fact, the anterior and posterior capsular ligaments of the atlas are only thin, fibro-cellular membranes, placed between the circumference of the foramen magnum and the anterior and posterior arches of this vertebra; these ligaments, along with the synovial capsules that cover the articular surfaces, are the only parts destined, in a particular manner, to maintain these surfaces in contact. *The condyles of the occiput* are eminences, whose articular surface is convex, turned downwards and outwards, and received into the superior concavities of the sides of the atlas, concavities that are strongly inclined inwards; we may, therefore, compare with justice the arrangement of these surfaces to that of a conical body, the apex of which, turned downwards, is received into a cavity of the same form. From this it results, that the atlas ought necessarily to follow the occiput in almost all its movements, and the proximity of the moderator ligaments, as we shall presently see, contributes to rénder the union of these bones still more firm; we, therefore, never find the head luxated at the first vertebra, unless in cases of organic lesion of the second vertebra or dentata.

The *articulation of the second vertebra or dentata with*

the atlas and occiput, is capable of very great motion: it is also more liable to be luxated than any other articulation of the spine. The superior surface of the body of the dentata is surmounted by a process named odontoid, and which is connected to the occiput by means of the odontoid ligament. The anterior surface of this process is in contact with an oval and concave depression, on the posterior surface of the anterior arch of the atlas: its posterior surface has a concavity that is separated from the transverse ligament by a synovial membrane. This ligament, which is extremely strong, is stretched between the sides of the atlas to which it is fixed, and forms, with the anterior arch of this vertebra, a sort of ring, that receives the odontoid process. On the sides of the first and second vertebræ, we also perceive horizontal articular surfaces, rather large, and separated by synovial membranes; lastly, besides these, we find ligaments that belong more particularly to the articulation of the atlas with the dentata, and which are distinguished, after their situation, into anterior and posterior, and a cervico-occipital ligament, that extends from the anterior edge of the foramen magnum, to behind the body of the fifth vertebra, and which helps to maintain together the dentata, atlas, and occiput. It is principally in the articulation of the dentata with the atlas, as we have already noticed, that the movements of the head are performed. This part of the body, placed on the extremity of the vertebral column, represents a lever of the first kind; and as its anterior part is larger and heavier, than its posterior, it happens, that whenever the muscles destined to counteract this are not in action, it falls forwards; this is observed in sleep, and explains to us why the occiput of the fœtus in delivery is generally the part first presented.

Dislocation of the first from the second vertebra may take place in two ways; the processus dentatus may be carried directly backwards, the transverse and moderator ligaments, &c. being at the same time ruptured; or it may slip under the transverse ligament, when the head is turned to the side in a violent act of rotation, the odontoid ligaments being torn through. The first

of these accidents is extremely rare, for, in order to produce it, an enormous force must act at the same moment on all the ligaments of this articulation, and rupture them by a direct strain. In the second kind of displacement, the violence does not act on the transverse ligament at all, but simply on the moderator ligaments, which are stretched and twisted spirally round the processus dentatus, hence a rupture of them is very easy. In children, this luxation, which is always mortal on account of the compression that it causes on the spinal marrow, is more to be feared than in adults; for in the first the processus dentatus being not yet completely developed, is not so high, and the ligaments are longer and not so strong as they afterwards become: hence it happens, that in consequence of a perpendicular movement the moderator ligaments may be easily torn, and allow the processus dentatus to pass under the transverse ligament without rupturing that fibrous cord. We ought, therefore, to be cautious and avoid lifting children from the ground in holding them by the head: the observations, so generally known, of E. L. Petit, show us very well the danger of this kind of play.

The five last cervical vertebræ are much less moveable or susceptible of luxation. The superior surface of their bodies is convex from behind forwards, concave in a transverse direction, and, united by a very elastic and thick fibro-cartilaginous layer, to the inferior surface of the vertebra above, which is formed in a contrary manner. Their articulating processes are slightly oblique, and slide on each other in the movements of lateral inclination and in rotation of the neck; we meet with partial luxations of these vertebræ, in which the two oblique processes, or one of these eminences only, are separated from the corresponding process of the next vertebra. Luxation, in consequence of a forced flexion of the vertebræ, can only be produced by an external cause, and it is the only one in which the displacement can take place in the two parallel articulations at the same time. On the contrary, luxation, arising from the rotation being carried beyond the natural limits, may be occasioned by the simple action of the muscles of this region.

CHAPTER VII.

ANTERIOR THORACIC REGION.

§ 101. The thoracic region occupies the superior portion of the trunk, and contains the principal organs of respiration and circulation. Internally, its form depends on the arrangement of its bony parietes, and resembles that of a cone flattened from before, with its apex turned upwards. Externally the lateral and superior parts of its parietes are contiguous to the superior extremities, and appear to be continuous with the shoulders, from which circumstance the upper part looks larger than the lower. In general, it is smaller proportionally to the rest of the body in the female than the male, and in children than adults. Its anterior part is bounded superiorly by the anterior cervical region and inferiorly by the free edge of the ribs and their cartilages. On the outer side it is continuous with the shoulders and lateral parts of the thorax. There is, however, no natural division between these two regions; but it is necessary to separate them for the purposes of study: we will imagine, then, an oblique line to pass through the centre of the clavicle and crista of the ilium, and this will serve as a limit externally to the part of the body which we are now going to consider.

At the superior part of this region and the top of the sternum, we observe on the median line a depression more or less marked, and at the outer part a prominence formed by the sternal extremity of the clavicle. Below the depression there is a flattened surface, which presents at its superior part a transverse projection, formed by the union of the two first pieces of the sternum, at an angle of a greater or less degree of obliquity, and at the lower part we observe a groove which corresponds to the ensiform cartilage. It is worthy of notice that in certain artisans, as shoemakers, who are obliged to exercise a greater or less degree of continued pressure on the inferior part of the sternum, this bone becomes deformed, and presents in this part a deep depression.

On each side of the sternum, especially in thin individuals, we observe a series of grooves and transverse eminences formed by the ribs and the spaces between them. Lastly, at the middle and external parts of this region the breast is situated, an organ which is found in a rudimentary state in man and children; but in women it is a hemispherical projection of a slightly conical form and directed a little outwards, which gives to the sternum the appearance of a vertical sulcus.

§ 102. The skin which covers the anterior surface of the thorax is much thicker towards the median line than on the lateral parts of this region. In the adult male we find a considerable number of hairs and sebaceous follicles. Towards the sides, the integuments are much more yielding; on the breast, in particular, they are white and fine. In the centre of these eminences, the size of which varies considerably, the nipple is situated, an erectile body of a conoid form and rosy tint, on whose surface the excretory ducts of the mammary gland open. The skin by which they are covered is reticulated, and contains very delicate hairs, and a great number of very fine papillæ. Around the base of each there is a circumscribed circle of a brown or rosy tint, called the *areola of the nipple.* In this part the skin is extremely sensitive.

§ 103. The layer of cellular tissue, which is situated immediately beneath the skin, is thick and fibrous in the centre of this region, where it is intimately joined in part to the integuments, and in part to the sterno-costal ligaments and external surface of the sternum. From this arrangement it happens, that in cases of anasarca the infiltration extends with difficulty to this part of the chest, and that, in general, its wounds, where there is loss of substance, do not heal by the first intention. Externally, this lamellated layer is much more yielding, which admits of the edges of wounds, with extensive destruction of the integuments, being brought into apposition. It may be divided, as M. Velpeau observes, into three distinct layers; the first, external, is closely connected to the integuments, and contains adipose vessels; it is also the continuation of the superficial fasciæ. The second, in the centre, is more loose;

and the third rests immediately on the muscles, being closely connected to them. In the middle and central part of this region, the subcutaneous cellular layer contains a great quantity of fat, and incloses in its substance the mammary gland. It is principally from this fatty layer that the breast derives its size: in girls this organ is not very large, but firm; in women it is of considerable size, and soft.

§ 104. The *mammary gland* occupies, in general, the space comprised between the third and seventh rib, and is of a semi-spheroid form, being compressed from before to behind; its circumference is not completely circular. Superiorly and externally it frequently extends to the axilla, and in different points it presents varieties of form and size which render its margin irregular. This gland consists of the re-union of a great number of distinct lobes, each of which is formed by the assemblage of small grains containing oblong vesicles, from which the radicules of the excretory ducts arise. These ducts converge towards the centre of the gland, and terminate in the middle of the nipple. A dense and fibrous layer of cellular tissue completely envelopes the mammary gland, and dips down between the different lobes which constitute it. This kind of membrane adheres so closely to the gland by its internal surface, that it is impossible to separate them without cutting either the one or the other. The external surface is covered by bundles of fat, and behind it adheres to the external surface of the pectoralis major by very loose cellular tissue; consequently, in the healthy state, this gland is perfectly moveable on this plane of muscle. The thick and resisting texture of the common covering of the mammary gland explains the cause of the length of time required before these abscesses break, and the septa formed by the processes which this membrane sends between the lobes and this gland, prevents the collection of pus which forms in these different parts from communicating with each other. When the mammary gland becomes scirrhous, it soon contracts close adhesions with the pectoralis major: the intercostals, the ribs, and even the pleura may also participate in the disease, and be removed by the knife, as was prov-

ed in a celebrated operation performed by M. Richerand.*

The breasts are supplied with a great number of blood-vessels, which come from the thoracic, axillary, intercostal, and internal mammary. In the natural state the caliber of these vessels is very small; but in cases of cancer they frequently acquire a considerable size. In the operation of amputation of the breast, it is essential to tie all the vessels when union of the wound by the first intention is desired, otherwise the blood collected at the bottom of the wound would act as a foreign body, and produce suppuration. If, from the state of the parts, the operation seems likely to be a long one, it is by far better for the operator to tie the vessels as he proceeds, not only to diminish the loss of blood, but also to prevent the open mouths of the vessels from contracting into the cellular membrane, by which the patient would be exposed to the chance of secondary hæmorrhage. Lastly, the arteries are nearly all placed at the upper part of the wound. The veins of the breast are divided into deep and superficial: the first follow the course of the arteries, and present nothing worthy of notice; the latter ramify beneath the skin, through which they may be seen with sufficient distinctness: around the nipple, and at the top of the breast, they form a very complicated anastomosing circle.

Lymphatic vessels arise in great number from the substance of the mammary gland and the neighbouring cellular tissue. Some few traverse the ganglia situated between the external side of the base of the breast and the pectoralis major. Others, not so numerous as the preceding, open into ganglia, situated at the lower part of the neck above the clavicle and the external edge of the sterno-mastoid muscle. Some of these ganglia are subcutaneous and easy of extirpation; but others are lodged deeply between the large vessels of this part, and in attempting to extirpate them the sub-

* {The operation of removing a portion of carious ribs, has been successfully performed in this country, by William A. M'Dowell, M. D. of Fincastle, Virginia. See American Medical Recorder, No. 41.—W.}

clavian arteries would be endangered. If, in cases of cancer of the breast, the superficial ganglia are affected, the operation may be performed; but as it is impossible to know beforehand whether the deep one participates in the affection, some surgeons have laid it down as a principle, never to amputate the breast when the lymphatic ganglia situated below the clavicle are affected by the absorption of the cancerous virus. But this opinion does not appear to us sufficiently well founded to induce the surgeon to neglect the only means which offer a chance of success. Lastly, most of the lymphatic vessels of the breast open into the ganglia situated in the axilla; hence these ganglia generally become enlarged in cases of cancer in the breast.

§ 105. The *pectoralis major*, on the external surface of which the mammary gland reposes, is very large, flat, and of a triangular form. It is attached to the inner half of the clavicle, to the external surface of the sternum, to the cartilages of the true ribs, excepting the first, and to an aponeurosis which is continuous with that of the external oblique and rectus muscles; from these two points the fleshy fibres converge towards the upper part of the humerus, to be inserted into the outer edge of the bicipital groove. The portion of the muscle which is situated in the region of which we are now speaking, is thin, and presents nothing remarkable. Its posterior surface covers a part of the bony parietes of the thorax, the subclavius, pectoralis minor, external intercostals, serratus magnus, and the thoracic vessels and nerves. The direction of the fibres of this muscle* regulates the mode of dividing the integuments in amputation of the breast; for if they were not divided obliquely, puckers in the cicatrix would arise each time that the fibres contracted, or that the patient carried the shoulder outwards.

§ 106. The *pectoralis minor*, situated beneath the for-

* {A recollection of this fact is also important in directing us to cut upon the subclavian artery below the clavicle. When the arm is extended at a right angle from the body, the fibres from the top of the sternum, and the sternal extremity of the clavicle are in a direct line with the course of the artery, and by cutting between them we soon arrive at the vessel. See § 129.—W.}

mer, is nearly of the same form, but much smaller. It is inserted by its base to the superior edge and external surface of the third, fourth, and fifth ribs; its fibres then converge outwards and backwards, to be inserted into the coracoid process of the scapula. The external surface of this muscle is separated from the pectoralis major by a thick layer of adipose cellular tissue, and by branches of the thoracic vessels and nerves. These arteries arise from the acromial, and ramify on the lateral and anterior parts of the thorax. The inferior thoracic is situated below the lower edge of the great pectoral muscle; they present nothing else worthy of notice. The posterior surface of the pectoralis minor is in contact with the ribs, the external intercostals, and serratus magnus.

§ 107. The *subclavius*, a small, round, fleshy bundle, is extended obliquely at the superior and anterior part of the thorax. It is attached internally to the cartilage of the first rib, takes a course outwards along a groove which is observed on the inferior surface of the clavicle, and terminates near the coracoid process of the scapula. Its external surface is covered by a thin, aponeurotic membrane, which descends from the clavicle and the coracoid process towards the first ribs. Its posterior surface covers the axillary vessels and nerves. Its inferior free edge is in contact with the same parts.

§ 108. The *sternum*, which constitutes the anterior portion of the parietes of the chest, is a single flattened bone, elongated and slightly inclined from above downwards, and from behind forwards. It is thicker at its upper than its lower part; and is composed of a spongy tissue abundantly provided with vessels. Its anterior surface is marked by four transverse lines resulting from the junction of the different pieces of which this bone is formed in the young subject. Sometimes the two first pieces rest moveable on each other, and there is a transverse articulation towards the upper three-fourths of the sternum: at other times there exists in this spot a foramen of greater or less size, which is only filled by a fibro-cartilaginous substance. Lastly, it may happen that the lateral points of ossification do not unite, and that this bone remains divided vertically

to a more or less considerable extent. The upper extremity of the sternum is very thick, and presents three depressions, one central, in which the interclavicular ligament is situated, and two lateral, which serve for the articulation of the clavicle. To its inferior extremity there is sometimes attached a cartilaginous, at other times an osseous elongation, the form and size of which vary, and which is called the xiphoid appendix, or cartilago-ensiformis. The sides of this bone are thick, and are articulated with the seven cartilages of the true ribs.

§ 109. The *clavicle*, with which the sternum is articulated, is a long bone placed above and in front of the chest, and directed obliquely from before to behind, within outwards, and above downwards, between this bone and the scapula, so as to cross obliquely the direction of the first rib. It is curved in the form of an italic *ſ*; hence its internal extremity is thicker than the rest of the bone, and instead of being articulated with the sternum at an obtuse angle, the apex of which is turned forwards, it takes not only a transverse direction, but is even turned backwards. From this arrangement it happens that the axis of this portion of the clavicle is always perpendicular to the articular surface of the sternum, even in the ordinary movements of the shoulder backwards. Although the natural obliquity of the bone be thus much increased, it is only when this motion is carried to its greatest extent, and is occasioned by an external force, that the axis of the sternal curvature of the clavicle forms with this articular surface an acute angle in front. Another arrangement of the sterno-clavicular articulation, which equally deserves the attention of the surgeon, inasmuch as it exercises a great influence on the dislocation of the clavicle, is, than in adult males, the surface, placed at the superior part of the sternum to receive this bone, presents a depression of a regular curved form bounded by two processes, which, in their turn, surround the articular surface of which we are speaking. In consequence of this it happens, that when the shoulder is carried forwards and backwards, the clavicle rolls on the bottom of the articular surface of the sternum, as

on a pivot, and readily finds a point of support in the processes which we have just mentioned. This construction of parts, by which the dislocation forwards of the sternal extremity of the clavicle is strongly opposed, exists but in an imperfect degree in women and children, and, consequently, in them these accidents are the most common. In fine, the situation of the cartilage of the first rib, which is immediately below the articular depression of the sternum, and the situation of the rib itself, which is placed above the level of the articulation, equally oppose the displacement of the clavicle upwards or downwards.

The ligaments which contribute to close this articulation are the anterior and posterior sterno-clavicular, the inter-clavicular, and the costo-clavicular, which last does not strictly enter into the formation of the articulation; but ascends obliquely from the internal and superior part of the first rib, to be attached to a projection, which is observed internally on the inferior surface of the clavicle. The inter-clavicular ligament is placed transversely above the superior extremity of the sternum, between the heads of the clavicle, from which it sends fibres to the deep fasciæ of the neck. The inferior tendons of the sterno-mastoid muscles contribute also to close this articulation, which presents. in its interior, synovial membranes, and a fibro-diarthrodial cartilage.

The dislocation of the sternal extremity of the clavicle downwards, is the only kind of displacement which has been regarded by authors as impossible.* M. Boyer has observed that there is no authentic case of dislocation backwards, upwards, or inwards,

* Sir Astley Cooper, in his work on "*Fractures and Dislocations*," when speaking of the dislocation of the sternal extremity of the clavicle backwards, says, "The only cause of this dislocation that I have known, was produced by great deformity of the spine, by which the scapula advanced, and sufficient space was not left for the clavicle, between the scapula and sternum, in consequence of which, the bone gradually glided back behind the sternum, and produced so much inconvenience, by its pressure on the œsophagus, as to lead to a necessity for the removal of its sternal extremity, which was performed with success by the late Mr. Davie, of Bungay, in Suffolk."—T.

and we have just seen how difficult these displacements are from the construction of the articular surface; hence the dislocation forwards may be regarded as the only one possible without the existence of fracture. Moreover, in an accident of this kind it is evident that the sterno-clavicular ligaments, and even, perhaps, a part of the tendon of the sterno-mastoid muscle, must be ruptured.

The body or middle part of the clavicle presents nothing remarkable; but its superficial situation, its form, which is cylindrical and curved in two contrary directions, and lastly, its compact and brittle structure, are so many circumstances which contribute to render its fractures frequent. Its use is very important; it is destined to keep the shoulder at a convenient distance from the trunk, to be the central point of all the movements of the superior extremity, and to support the efforts of this limb on the trunk. Fracture of the clavicle may take place in all parts of this bone; but it is in those where it is curved that it most frequently happens. The internal fragments, being drawn in an opposite direction by the sterno-mastoid pectorales and subclavius, experience but a slight displacement. The external extremity is, on the contrary, always drawn downwards by the weight of the arm, the direction of which is perpendicular to the axis of the clavicle, and by the contraction of the deltoid, and forwards and inwards by that of the great pectoral; hence it passes beneath the internal extremity.*

§ 110. The costal cartilages, with which the sternum is articulated by its lateral portions, amount to the same number as the ribs. Their length increases from the first to the seventh, and then progressively diminishes. The first are placed nearly horizontally, but the others more obliquely from behind forwards. The

* {The bold and novel operation of completely extirpating the clavicle in a case of osteo-sarcoma of that bone, has recently been performed by Professor Mott of New-York, with the most complete success. The details of this interesting and important case, which reflects such high honour upon the professional skill of the distinguished surgeon, will be found in the American Journal of the Medical Sciences, No. 5.—W.}

cartilages are white, elastic, and have a great tendency to ossify. It is to their elasticity as well as that of the ribs, that the fractures of the sternum are of such rare occurrence. Indeed this bone might be easily carried backwards by any external violence, and then it transmits the pressure exercised on it to the ribs and cartilages on which it is sustained. The great flexibility and elasticity of the costal cartilages have led some to think that they cannot possibly be fractured by the same causes which produce, in general, the fracture of the ribs, unless indeed the cartilages be completely ossified. This accident has hitherto only been observed between the fifth and eighth ribs; and the fracture, instead of being oblique and ragged, is clean and perpendicular. The internal fragment is carried nearly always a little forwards, in consequence of the contraction of the internal intercostals, which alone unite these cartilages together, and of the triangularis sterni, the horizontal digitations of which are attached to the ribs corresponding to the cartilages on which fracture has been observed.

§ 111. The *ribs*, which complete externally the bony parietes of this part of the thorax, are very elastic bones, curved in several directions, flat, and rather thin anteriorly. Their obliquity from before to behind increases in proportion as they descend. Their curvature and breadth diminish from the first to the twelfth. The upper ribs have also their external surfaces directed more upwards, and their inferior edge turned outwards. The seven first ribs are articulated by the medium of the costal cartilages to the sternum, whilst the five last cartilages do not reach this bone. The two last ribs are loose and floating.

Although the chest is not uncommonly exposed to external shocks, fractures of the ribs are not common. This depends on the length, curve, oblique situation and mobility of these bones, as well as the elasticity of their cartilage. The first are moreover protected by the bones and the muscles of the shoulder, from which cause they are less subject to fractures than the middle, which are very much more exposed. Lastly, fracture of the two last ribs is scarcely possible, on account

of their great mobility. These accidents may be produced by a cancer acting directly on the fractured point, or by a force applied on the anterior and posterior extremities of the ribs, increasing their angle to so great a degree as to cause the fracture. In the first of these cases the fragments are pushed inwards, whilst in the second they are carried outwards. The ribs can never experience any displacement in the direction of the diameter of the bone, nor in that of its length. for, being fixed to the vertebral column behind, and the sternum in front, they cannot be shortened, and the same muscles being attached to both fragments, keep them at equal distances from the neighbouring ribs. If, however, fracture of one or more ribs takes place in front of the attachments of the serratus magnus, the external portion is drawn outwards, and the internal slightly in the contrary direction.

§ 112. The spaces between the cartilages and the ribs are much greater in this region than at the posterior part of the thorax; and are occupied by the intercostal muscles, vessels, and nerves. The *external intercostals* are fleshy bundles, which extend from the vertebral columns to the spot at which the ribs are joined to their cartilages. Their fibres take an oblique course from above downwards, and are attached to the external labium of the inferior edge of one, and to the superior edge of the following rib. Anteriorly, these muscles are continuous with very thin aponeuroses, which extend as far as the sternum.

The *internal intercostals*, situated behind the preceding, are attached superiorly to the internal labium of the ribs and their cartilages, and inferiorly, to the superior edge of the following rib, from the sternum to the angle of these bones. Thin fleshy fibres proceed obliquely from above downwards, and from before backwards, and, consequently, intersect the direction of those of the external intercostals. A thin layer of cellular tissue separates these two fleshy layers, and contains in its substance the intercostal vessels and nerves.

§ 113. The *intercostal arteries* arise from the lateral and posterior parts of the aorta, with the exception of

the first, which is furnished by the subclavian. These vessels first take a serpentine course between the pleura and external intercostal muscles, in the middle of the space which exists between the ribs, but they soon divide into two branches, which enter between the layers of muscle of which we have been speaking. The inferior branch, rather small, goes forwards for some distance along the upper edge of the rib situated below, and then subdivides on the external surface of the bone. The superior branch, of a much greater size than the former, is situated in a groove in the inferior edge of the rib above it. Towards the anterior third of the bone, it proceeds downwards, and occupies the middle part of the intercostal space. It is for the purpose of avoiding this vessel that, in the operation of empyema, it has been recommended to make the opening into the chest nearer the upper than lower or sharp edge of the rib. If, in a penetrating wound of the chest, the intercostal artery has been opened, it is plain that, from its situation, the vessel can scarcely be secured; but it may be compressed by the introduction of a pledget into the bottom of the wound, the size of which would not allow of its being easily withdrawn. This simple plan, which is at present generally employed, is much preferable to that recommended by Gerard, which consists in putting a ligature round this vessel and of the rib in whose groove it is lodged.

§ 114. Behind the internal surface of the sternum and the costal cartilages, the *triangularis sterni* is situated, which extends from the cartilago ensiformis to the level of the fourth costal cartilage. Its fibres then take a course upwards, forming digitations, the length and straightness of which increase in proportion as they descend, and which are attached to the internal surface and inferior edge of the cartilages of the second, third, fourth, fifth, and sixth ribs. The anterior surface of this muscle is covered by these cartilages, the internal intercostal muscles and the *internal mammary vessels*. The internal mammary artery (§ 87.) descends behind the costal cartilages, gradually approaching the sternum. Its deep situation renders the

securing of this vessel by ligature extremely difficult, an operation, however, seldom required. To perform it, the integuments must be divided parallel to the sternum, and then the muscles and cellular tissue situated on one of the intercostal spaces. As to the branches which are given off by this artery, they are in general too small to deserve attention.

§ 115. The internal surface of the parietes of the thorax is lined by the *pleuræ*, thin, diaphanous, serous membranes, which are reflected on themselves to cover the lungs. From the approximation of these two closed sacs a septum is formed, in the substance of which two spaces exist, the anterior and posterior mediastina. The pleura of the left side leaves the cartilages of the ribs at the edge of the sternum; that of the right side separates from this bone near the median line. But instead of descending in a straight line, the right pleura turns over to the left side close to the cartilage of the fourth rib. From this arrangement, which has been very well described by Rosenthal, it happens that the *anterior mediastinum* is formed of two small pyramidal cavities united by their apices. The inferior portion, larger than the superior, corresponds to the diaphragm by its base, and to the cartilage of the fifth rib by its apex; it lodges the heart, but is filled anteriorly by fatty cellular tissue, which communicates with that of the abdomen, through a space left in the fibres of the diaphragm on the sides of the ensiform cartilage. It is generally in this part that abscesses of the mediastinum are formed; the thickness which the two layers of this septum acquire during the formation of the abscesses, allows very little of the purulent matter to get into the chest, although this occurrence is not impossible. Hence the matter almost always opens externally; sometimes it passes through the sternum; at others, it proceeds by the side of this bone, either to the base of the neck, or between the cartilages of the ribs, or near the ensiform cartilage. If the opening of the abscess is situated on the sternum or at the base of the neck, and is not sufficiently large for the pus to freely escape, it has been advised to trephine this bone: the operation is easily performed, and the consequen-

ces are not in general very serious. At the superior part of the anterior mediastinum the *thymus gland* is situated. This body, the use of which is not known, consists of two lobes; its texture is soft, form oblong, and size different at various periods of life. In the fœtus it extends from the diaphragm to the thyroid body, but in the adult it diminishes, and in old age almost entirely disappears. It is covered by the sternum, and the lower portion of the sterno-hyoidei and sterno-thyroidei muscles; posteriorly, it is connected with the trachea, the inferior thyroidean veins, left subclavian vein and superior vena-cava, the arch of the aorta, and the pericardium. When this body increases in size, as it sometimes does in scrofulous children, very serious symptoms are produced, for the tumour which it forms is pressed back by the sternum, and compresses the parts situated between it and the vertebral column. The pressure exercised on the œsophagus and on the trachea may be so great as to destroy the patient from inanition, or asphyxia. When this disease resists internal means, Burns advises the extirpation of the tumour to be tried. The following is the operation which he proposes. An incision being made at the anterior part of the neck, immediately below the sternum, and between the sterno-hyoidei muscles, as in the operation for tracheotomy, the superior extremity of the thymus gland is uncovered, and with the fore finger this body is to be detached as much as possible from the neighbouring parts; after which it must be seized with forceps, introduced with caution between it and the mediastinum, and then drawn out. But the surgeon will be seldom warranted in performing this operation; for it almost always happens that the mesenteric glands participate in the morbid state which has occasioned the swelling and induration of the thymus; therefore, the extirpation of this organ, although it might cause the dyspnœa to cease with which the patient is affected, would not preserve his life. When, by the advance of age, the thymus is diminished, the superior extremity of the mediastinum is filled with cellular tissue, which communicates with that situated at the anterior and inferior part of the neck, and is continuous with

that which always occupies the inferior portion of this septum; hence, it is not very rare to see abscesses which have formed behind the deep fascia of the neck, descend into the thorax, and even appear in the epigastric region.

§ 116. At the inferior part of the anterior mediastinum, a membranous sac is situated, which envelopes the heart and the commencement of the large vessels, and is called the *pericardium.* It is surrounded by a great quantity of fat, and covered anteriorly by the pleura, except at its middle part, where it corresponds to the thymus and inferior division of the mediastinum; laterally, it is separated from the sternum and the cartilages of the ribs by the anterior portion of the lungs. In cases of dropsy of the pericardium, it is sometimes necessary to open this membranous sac. To perform this operation, Senac advises a trochar to be introduced between the third and fourth costal cartilages of the left side, about two inches from the sternum, and to be directed obliquely towards the origin of the ensiform cartilage, passing it along the ribs, in order to avoid the internal mammary artery and the lungs; but this operation is so dangerous, that no one would resort to it. Desault, in order to open the pericardium, laid bare the parietes of the thorax, between the sixth and seventh ribs of the left side. This operation, although infinitely less dangerous than that proposed by Senac, is not free from objections: for the large opening in the parietes of the chest, allows air to get into its cavity, and the distance of the external opening from that of the pericardium renders the effusion of a portion of liquid into this cavity almost inevitable. The method proposed by M. Laennec and M. Skeilderup is much preferable, for it is not only free from the objections which we have just mentioned, but its execution is easy, and it allows the diagnosis to be verified before the pericardium is opened. This operation consists in the application of the crown of a trephine at the inferior part of the sternum, between the ensiform cartilage, and the place where the cartilage of the fifth rib is united to that bone. An opening is made in this triangular space; and the instrument

reaches the pericardium without injuring the pleura, and, consequently, without opening the cavity which lodges the lungs.

§ 117. The *heart*, placed obliquely in the membranous sac, of which we have just spoken, is of an irregular conical shape, the base of which is turned upwards, backwards, and a little to the right side, and the apex downwards, forwards, and to the left side. The size of this muscular organ varies very much in different persons; generally, however, it is larger in proportion during infancy than at a more mature age; superiorly, it is occupied by the auricles and inferiorly by the ventricles. The parietes of these last cavities, on contraction, strike against the sternum, the fifth intercostal space and the sixth left rib; the shock or sensation of elevation thus produced, is rendered sensible by the stethoscope, even when it cannot be felt with the hand, and its intensity is generally in an inverse ratio to the extent of the pulsations of the heart, and a direct ratio to the thickness of the walls of the ventricles. The contraction of the auricles very seldom produces a similar phenomenon, and this sign, compared to the intensity of the noise which the pulsations of the heart produce, is one of the surest means for recognising the state of the ventricles. This noise is best audible at the inferior part of the sternum, when it depends on the contraction of the right cavities of the heart, and between the costal cartilages, when it belongs to the left cavities of this organ.

From the situation of the heart it is evident that in penetrating wounds of the left side of the chest, this organ is most exposed. Indeed on the right side it does not go beyond the sternum, whilst on the left it extends to some distance beyond this bone. The right ventricle is most exposed to the action of sharp instruments, which rarely reach the left and still more rarely the auricles. This is owing to the left ventricle being situated behind the right, and to the right auricle being placed behind the sternum, and resting on the diaphragm, and to the left being entirely concealed by the large vessels of the base of the heart. The parietes of the auricle are so thin that it is impossible for an in-

strment to wound them without opening their cavities. But this is not the case with the ventricles, for their parietes are so thick (especially those of the left) that they may be wounded without the instruments penetrating into their cavities.

§ 118. In penetrating wounds of the chest, the large vascular trunks which proceed to the heart, and pass from it, are equally exposed to the action of sharp instruments; their wounds, especially those of the arteries, are almost always mortal. From their situation it is evident that they can be opened, not only in wounds of the anterior part of the chest, but also in those of the base of the neck or of the top of the thorax, if the instrument be directed downwards. The first of these vessels, behind the sternum, is the *superior vena-cava*, which is formed by the union of the two subclavian veins, and brings to the heart all the blood of the head, the upper extremities, and of a portion of the chest. It commences on a level with the cartilage of the first rib; descends a little to the left and front part, immediately behind the cartilages of the ribs and the edge of the sternum, passes into the pericardium, and opens into the right auricle of the heart, behind the sixth rib. It is covered by the thymus gland, and cellular tissue of the mediastinum, and corresponds on the right side to the lung, and on the left to the portion of pericardium which ascends on the aorta. Behind this vessel the right superior pulmonary vein and aorta are situated.

The *pulmonary veins*, two in number on each side, open into the inferior and right part of the left auricle. The pulmonary artery rises from the superior and left part of the right ventricle, passes obliquely upwards, and to the left side, before the aorta, and, after a course of about two inches, divides into two trunks, which separate from each other, and proceed transversely towards the roots of the lungs. From the middle of this bifurcation, the arterial canal arises, which is obliterated in the adult, but which, in the fœtus, establishes a communication between this vessel and the aorta. The pulmonary artery of the right side passes behind the superior vena-cava and aorta, forms an arch around the bronchi of the same side, and bifurcates before passing

into the lung. That of the left side passes before the aorta, above its arch, and then proceeds in the same manner as the one above described.

The *phrenic nerve*, which descends along the lateral and anterior part of the neck, and penetrates into the chest between the subclavian vein and artery, proceeds inwards, forwards, and downwards into the anterior mediastinum; it continues its course on the trunks of the pulmonary vessels, then between the pleura and lateral parts of the pericardium to reach the diaphragm.

The *aorta* arises from the base of the left ventricle, behind the pulmonary artery, to which it is joined by a great quantity of fatty cellular tissue. It then proceeds upwards, first between the vena-cava and pulmonary artery, and ascends in front of the vertebral column by describing a curve, the convexity of which is turned forwards and to the right side. On a level with the third or fourth dorsal vertebra, this artery entirely leaves the pericardium, and by continuing the curvature to the back part and left side, proceeds transversely, on a level with the second dorsal vertebra, and forms what is called *the arch of the aorta.* This curve terminates on the left side of the body of the third dorsal vertebra; proceeding from this part, the aorta becomes vertical, and descends along the anterior and left part of the vertebral column in the posterior mediastinum.

In the interior of the pericardium the aorta is only separated from the sternum by the mediastinum, and is connected at the right side with the superior vena-cava and the lung; still higher up it is covered by the thymus gland. When aneurisms form in the ascending portion of the aorta, the pressure exercised by these tumours on the anterior wall of the thorax often causes the absorption of a portion of the sternum and the ribs, and thus they frequently open externally. Corvisart saw a case in which luxation of the sternal extremity of the clavicle had been occasioned by an aneurism of the aorta. But, generally, when these tumours form an external projection, it is at the base of the neck that they are situated, and at this place they are sometimes confounded with aneurisms of the subclavian; hence, Burns advised that the ligature should never be put

around this vessel, unless the finger could be put between the tumour and the top of the chest. The relations which exist between the origin of the aorta and the pulmonary artery explain how aneurisms of the ascending aorta open into this vessel; but this termination, which has been observed by MM. Payen and Zeink, is extremely rare. Corvisart saw an aneurism of the ascending aorta compress the superior vena-cava, and thus produce a considerable impediment to the return of the blood from the upper parts of the body to the heart. The arch of the aorta rests posteriorly on the trachea, a little above the origin of the bronchi, and its concavity, turned downwards, surrounds the left bronchus and the left pulmonary artery. It, therefore, often happens that aneurisms of the ascending aorta, or of the arch, compress the trachea or the bronchial tubes, and even open into them, suddenly producing a mortal hemoptysis. The cavity of the left pleura is the place where the greater part of aneurisms of the thoracic aorta open. It is, on the contrary, very rare to see them burst into the right pleura; indeed, the left side of this vessel is connected with the pleura of the same side, whilst on the right side it is separated from it by the œsophagus, the thoracic duct and vena-azygos. Aneurisms of the aorta may open into the œsophagus, but this is not of very common occurrence. The obliteration of the thoracic duct and the enlargement of all the lymphatic vessels, are among the effects of the development of tumours of this kind. The pressure which is exercised on the body of the vertebræ with which the aorta is connected posteriorly, often causes the destruction of these bones to a greater or less extent. Lastly, compression of the lungs, and, consequently, difficulty of respiration, are the most ordinary effects of this disease.

The arch of the aorta gives origin to the arteria innominata, left carotid, and left subclavian arteries. The first of these vessels is the most anterior, and ascends obliquely beneath the left subclavian vein, the sternum and the sterno-thyroidei muscles. Lastly, the carotid and subclavian arteries occupy the superior extremity of the mediastinum: but as we have

before pointed out the principal relations of these vessels, we shall not now return to them.

The *inferior vena-cava*, which empties itself into the right auricle, is situated between the heart, œsophagus and lungs. It is evident that these parts cannot compress it so as to obliterate it; but the circulation may be impeded by the increase of the size of the heart, the swelling and hepatization of the lung, &c.; hence. M. Velpeau attributes to this cause, and in our opinion with correctness, the swelling of the liver, which is observed so often in diseases of this kind.

From what we have said of the arrangement of the heart and the large vessels of the chest, it is evident that, in the case of a penetrating wound of the chest, accompanied with internal hæmorrhage, it would be very difficult to know from which vessel the blood escaped; and if we knew, our knowledge would be of little avail; these accidents are always fatal. However, we will observe, that sharp instruments, directed horizontally, cannot reach the heart, unless they penetrate above the sixth rib.

§ 119. The *trachea* occupies the superior part of the posterior mediastinum, and descends on a level with the second or third dorsal vertebra, between the thymus gland, the left subclavian vein, the arteria innominata, the arch of the aorta, the œsophagus and vertebral column. At its inferior extremity, this fibro-cartilaginous tube bifurcates in order to penetrate into the lungs, and then takes the name of bronchi. The bronchus of the right side, thicker, shorter, and more horizontal than the left, is surrounded by the arch which the right pulmonary artery forms, and by the vena-azygos. The left bronchus, situated a little more posteriorly than the former, is surrounded by the aorta and left pulmonary artery. Before the bifurcation of the trachea, and around the bronchi, a great number of lymphatic ganglia are situated, which are called the *bronchial glands.* These bodies, the form and size of which vary considerably, are of a black colour and of slender consistence. In a great number of cases, but principally in scrofulous affections, the bronchial ganglia may increase in size, and undergo morbid alterations of different kinds:

and from their anatomical arrangement, it is evident that they may either compress the bronchi, the pulmonary vessels, or even the œsophagus, thus producing symptoms which may be confounded with those occasioned by the formation of an aneurism of one of the large vessels of the heart.

The *pneumo-gastric nerves* penetrate into the chest behind the subclavian vein. That of the right side passes before the subclavian artery; that of the left passes over the arch of the aorta. These nerves then pass backwards, increasing in size, and giving branches to the pulmonary plexus; they then pass behind the bronchi, and, lastly, meet on the aorta to reach the abdomen. It is to the pressure, exercised by aneurisms of the arch of the aorta, on the recurrent nerves which arise from the pneumo-gastric, and surround this vessel or the subclavian artery in its ascent towards the larynx, that certain surgeons have attributed the loss of voice in persons attacked with this disease.

The *œsophagus*, in the chest, is situated in the posterior mediastinum behind the trachea, the left bronchus and base of the heart, before the vertebral column, the curve of the vena-azygos, and the thoracic duct, and between the aorta and lungs. Its lower part is surrounded by the pneumo-gastric nerves, which then take the name of œsophageal cords. On account of the size of this muscular tube, and of its deep situation, it is very seldom affected in penetrating wounds of the chest, unless they be produced by fire-arms; and then the lungs always participate in the injury.

The *vena-azygos* communicates with the superior vena-cava immediately above the right bronchus, around which it turns to descend on the anterior surface of the dorsal vertebræ, by the side of the aorta and before the intercostal arteries. This vessel receives the intercostal veins, and opens into the inferior vena-cava, or into one of the lumbar veins. From this arrangement, it is evident that if the circulation were interrupted in one of the venæ-cavæ, between the points where they communicate with the azygos, the blood would still not be prevented from arriving at the heart.

§ 120. On each side of the mediastinum, the pleura

is continued over the root of the lungs, and the external surface of these organs. The costal portion of this membrane is in connexion internally with the outer surface of its pulmonary portion, and by the membrane a cavity is formed, which, in the natural state, only contains a little serum. One of the most common effects of peripneumonia is the formation of adhesions between these two portions of the pleura, and in this way the cavity of the thorax may be completely destroyed. It is equally possible, that partial adhesions may take place so as to completely surround a more or less considerable portion of the cavity of the pleura, which being filled with purulent matter may thus present all the characters of a simple abscess. At other times the liquid effused into this membranous sac is collected at the most depending parts of the thorax. These differences generally depend on the previous existence of adhesions or effusion into the chest; indeed, if a considerable quantity of liquid separates the two folds of the pleura from each other, before union has taken place, partial adhesions only will form, and the effused matter will not be circumscribed. If, on the contrary, the adhesive inflammation first appears, it may happen that the spot where the effusion takes place is surrounded by adhesions, and separated from the rest of the cavity of the pleura, before this state comes on. In penetrating wounds of the chest, for example, the effusion may occupy the most depending part of the chest, or be circumscribed in the neighbourhood of the wound, according as it takes place before or after the formation of these adhesions. These kinds of abscesses may be formed in every part of the chest; but it is, generally, at the anterior part of the true ribs, under the breasts, or near the clavicle, that they are situated. They take a direction across the pleura and intercostal muscles, and form, externally, a small tumour, circumscribed superiorly and inferiorly by the ribs. In abscesses of this nature, the spot where the opening must be made for giving exit to the effused liquid, is indicated by the situation of the tumour; but this is not the case when the effusion is not circumscribed. The operation of empyema ought then to be per-

formed at the spot most favourably situated for the discharge of the liquid, and for its safe and easy performance. The exact spot cannot be fixed in any absolute manner.

The lungs nearly fill the cavities which exist between the mediastinum and parietes of the chest, all the movements of which they follow. These organs, being the largest of the thoracic viscera, are also those most frequently injured in penetrating wounds of the chest. Emphysema, or infiltration of air, is sometimes one of the effects of these wounds, especially when several air-cells have been opened without injury of any considerable vessel, and when the external wound does not exactly correspond to that of the lung. This complication, which may become very serious, is sometimes the effect of fracture of the ribs, when the fragment of the broken bone penetrates into the substance of the lung. When the wounds of the parietes of the thorax are considerable, instances of hernia of the lung have been seen; but the reverse generally takes place, for atmospheric air penetrates into the cavity of the chest, and the lung on the wounded side wastes away. It is on this ground that some have advised the operation of empyema never to be performed on both sides at the same time.

§ 121. The *diaphragm*, which forms the whole inferior wall of the thorax, is attached to the ensiform cartilage, to the internal surface of the cartilages of the six lowest ribs, and the vertebral column. It forms, when contracted, a plane inclined from below backwards; but, when it is in the state of relaxation, the central portion is not situated on the same level with its circumference. Indeed, its superior surface, instead of being flat, becomes convex, and is raised high up in the chest. This arrangement is more remarkable on the right than the left side, and the most elevated part of the diaphragm is sometimes seen on a level with the sixth rib. The centre of this muscle is occupied by an aponeurosis, from the circumference of which fleshy fibres proceed forwards, backwards, and to each side. The central portion superiorly corresponds to the mediastina, and is intimately united to the pericardium; laterally, it is connected with the base of the lungs, and

is lined by the pleura. Lastly, its circumference rests on the triangularis sterni, and internal intercostal muscles, and posteriorly on the aorta. It is evident that the depth and narrowness of the sulcus, situated between the circumference of the superior surface of the diaphragm, and the lateral parietes of the thorax, at their lower part, will be great in proportion to the relaxation of the muscle and its ascent into the interior of the thorax. In the vertical position, this sulcus is the most dependent part of the chest, and, consequently, that where the effused liquids in the pleura accumulate; but nevertheless it is not the spot where the operation for empyema ought to be performed; for the portion of the diaphragm which corresponds to the last intercostal spaces, may rest immediately on the interior surface of the pleura-costalis; hence, in operating in these spots, the surgeon would be exposed to the risk of dividing this muscle, and of penetrating into the abdomen, instead of making an opening into the thorax. Another reason for performing the operation rather high is, that the part of the chest where the membranous exudations are deposited in greatest abundance, is precisely that now under consideration. Moreover, in changing the position of the patient, the most dependent part of the chest is also changed: when the patient rests on the diseased side, a position natural to all those affected with effusion into the chest, the centre of the lateral part is the most dependent. Hence, as M. Laennec has observed, the spot for performing the operation for empyema ought to be chosen in the middle of the fourth intercostal space, and not, as most surgeons advise, between the sixth and seventh ribs. In either case, the intercostal artery must be avoided, and for this purpose, the incision should be made as far as possible from the inferior edge of the ribs.

CHAPTER VIII.

POSTERIOR THORACIC, OR DORSAL REGION.

§ 122. In this division of the trunk, we comprise all the parts situated between the inferior boundary of the posterior region of the neck and the lower border of the last rib, and between the median line and an imaginary one which corresponds to the posterior costa of the scapula. On the median line, which separates the two dorsal regions, a kind of crista may be observed, formed by the spinous processes of the dorsal vertebræ, and which is bounded on each side by a groove of no great depth, on the exterior of which an equally vertical projection is situated,—more marked at the inferior than the anterior part of this region, and formed of bundles of muscular fibres.

§ 123. The integuments of the dorsal region are firm, thick, smooth, and contain sebaceous follicles in great abundance. Their sensibility is greater than one would imagine from the few nerves with which they are supplied. The subcutaneous cellular tissue, firm, serrated, and in layers, is continuous with the superficial fascia of the neck, and the subcutaneous cellular tissue of the anterior parietes of the thorax; it abounds in fatty vesicles, and is very intimately connected with the skin at the vertical crista. formed on the median line of the back by the spinous processes of the vertebræ. Beneath this cellular layer, we find an aponeurotic expansion. the thickness and appearance of which vary in several parts of this region; it covers the posterior surface of the trapezius and latissimus dorsi, and firmly adheres to them; near the scapula it is continuous with an analogous layer, which unites the anterior layer of these muscles. This layer of subcutaneous cellular tissue is lodged between the integuments, the thickness and density of which are very considerable, and the resisting plane formed by these cellulo-aponeurotic layers and the muscles which they envelope. Hence, when suppuration occurs in this part, the mat-

ter, instead of distending the skin and making its way externally, in general dips down to a considerable distance between the layers of the tissue. Thus, as M. Velpeau has truly observed, purulent collections of this nature may produce a considerable separation of the skin, extend to the neck or loins, and become very dangerous from the resistance offered by the parts to the exit of the pus. In these cases free incisions must be made very early into the abscess.

§ 124. The trapezius, of which we have already spoken, (§ 94) forms, with the latissimus dorsi, the first layer of muscles in the dorsal region. The superior half of the trapezius covers the posterior part of the neck, its inferior part extends on the back from the spine of the scapula to the spinous process of the last dorsal vertebra, and covers the superior and internal part of the *latissimus dorsi*. This last muscle is thin, large, and irregularly quadrilateral; one portion of its fibres is inserted into the three or four last ribs; but the greater part arises on the external border of a strong aponeurosis which is fixed to the spinous processes of the six or eight last dorsal and all the lumbar vetebræ, to the sacrum and the posterior half of the crista ilii. This aponeurosis is very large at its inferior part, but superiorly is contracted, and appears to furnish the layers which are interposed between the deep muscles of this region. The fleshy fibres of the latissimus dorsi converge towards the inferior angle of the scapula, and terminate by a tendon, which is fixed into the upper third of the humerus.

§ 125. The *rhomboidei*, situated at the lower part of the neck and upper part of the back, are large, thin, and nearly square; they are covered by the trapezius, the latissimus dorsi, and the triangular portion of the common aponeurosis, which fills the space that these two muscles leave between them near the scapula. These muscles are fixed, in part, to the inferior portion of the cervical ligament, and to the spinous processes from the last vertebra of the neck to the fourth or fifth of the back, and in part to the spine of the scapula. The posterior and superior serratus is situated beneath the rhomboid; it is very thin, and divides into four di-

gitations, which are fixed to the ribs from the second to the fifth. Towards the vertebral column the fleshy fibres of this muscle terminate by a very thin aponeurosis, which commences on a level with the external border of the splenius, and sacro-lumbalis, and is attached to the cervical ligaments, and the spinous processes of three or four dorsal vertebræ. The lower edge of the posterior and superior serratus gives atachment to an extremely thin aponeurotic layer, which is fixed to the angles of the ribs externally, to the spinous processes internally, and to the upper edge of the serratus magnus inferiorly. This aponeurosis completes behind, the kind of sheath, half bony and half membranous, which lodges the vertebral muscles. The posterior surface of the serratus is connected with the rhomboid, the levator anguli scapulæ and the trapezius ; it is separated by a space, the extent of which varies according to the position of the shoulder, and which is filled with loose cellular tissue deprived of fat. This space is continuous under the scapula, with the inferior and external portion of the fore part of the neck, which circumstance accounts for the descent of matter that forms in this part. Lastly, in cases of fracture of the middle part of the ribs, we see, according to the points of attachment of this muscle, that its contraction tends to carry the posterior fragment outwards.

The fleshy fibres, which occupy the vertebral arches, united into one in the lumbar region, form in the back two distinct muscles, the longissimus dorsi and sacrolumbalis; but they present nothing in their arrangement worthy of notice. This is also the case with the arteries which ramify in this part, the most of which are branches from the intercostals. The veins, lymphatics, and nerves, also present nothing of interest.

§ 126. The frame-work of bones at the posterior part of the thorax, is formed by the dorsal portion of the vertebral column, and in part by the ribs. The posterior surface of the vertebral column, which we observed to be concave in the neck and convex in the back, becomes again concave in the lumbar region. These differences, which do not exist in early life, correspond to the degrees of thickness which the bodies

of the vertebræ, and the intervertebral cartilage present behind and before in each of these regions, and appear to depend on purely mechanical causes. Indeed, in the new-born babe, the vertebral column is nearly straight; but the head tends constantly to fall forwards, the muscles of the posterior part of the neck are nearly always contracted to keep it in the horizontal position, and gradually approximate the parts to which they are fixed; this determines the first curvature, the concavity of which corresponds to the insertion of these muscles. On the other hand, the weight of the head, of the thorax, and of the superior extremities tending to curve the column anteriorly, must necessarily act where the muscles of the posterior part of this framework of bone have the least force, viz. in the back. In the lumbar region, the muscles being much more powerful, the equilibrium destroyed by the flexion of the spine forwards in the dorsal region, is restored in the loins, and a curvature is formed at this part, the concavity of which looks backwards. Thus, when, by the progress of age or any other cause, these muscles are considerably weakened or even paralysed, we find the vertebral column gradually yielding to the power which tends to move it forwards, and the back becoming quite round, not only between the shoulders, but also at its lower part. The most common malformation of the vertebral column is the incurvation forwards. This kind of deformity, which is an excess of the natural curvature of the column, is that which entails, in general, the fewest inconveniences.

In most subjects the dorsal portion of the vertebral column presents again a slight lateral curvature. This curvature is much more frequent on the left than the right side, and appears to depend on the contraction of the vertebral muscles of the left side, a contraction necessary to be opposed to the bending of the column, when heavy burdens are raised with the right arm. Indeed, Beclard observed, that in left-handed people the lateral curvature, instead of being to the left, as in persons who habitually use the right hand, was situated to the right side. The deformity, produced by the lateral incurvation of the vertebral column, may also

depend on mechanical causes, analogous to those of which we have just spoken, without the bodies of the vertebræ being the seat of caries. It is not rare to see the spine present two curves in opposite directions, but on the same plane with each other, which prevents the obliquity of the body, a necessary consequence of the other kinds of incurvations. In all cases these malformations produce a shortening, to a greater or less degree, of the trunk, and are accompanied with a deformity of the ribs. When the incurvation of the dorsal portion of the vertebral column takes place, the space comprised between the left side of this bony frame-work, and the anterior parietes of the thorax, and which lodges the heart, is more or less diminished, by which circumstance a considerable disturbance in the circulation takes place, which more particularly manifests itself at the time of puberty.

From what we have said above on the mechanism of the formation of deformities, it is evident that one of the most effectual means for arresting their development is the horizontal position; indeed, the causes which tend to produce incurvation of the spine in the vertical position, do not then act in the same way. In fulfilling this indication, and in employing the mechanical means necessary to restore the natural shape, the progress of deformities of this kind has not only been arrested, but even a complete cure has been effected. But, unfortunately, the curvature of the vertebral column does not always depend on the causes which we have just mentioned. It may be occasioned also by the caries of the body of one or more vertebræ. From the commencement of the disease, the curvature is almost always directed backwards, and is much more acute than in the other cases of deformity. Hence the spinal canal, in general, is considerably contracted, and the spinal marrow compressed, so as to occasion paralysis of the parts situated below—a complication which is never found in those incurvations that do not depend on caries. It has also been observed that when the caries of the vertebral column is superficial, it is not accompanied with a curvature of the spine, but gives rise to the formation of abscesses by congestion.

The vertebræ of the dorsal region being articulated so as to permit but very limited motions, their dislocation without fracture is scarcely possible. Indeed, the articular processes are much more elevated, and present a more vertical direction in the back and the loins than in the neck; and in order that those of the superior be placed before those of the lower vertebræ, it would require these bones to be bent much more forwards than their inter-vertebral substance would allow. The fracture of the spinous processes is, on the contrary, more common in the dorsal than the cervical region; indeed, the prominences are much longer and more superficial. The manner in which these processes lock into each other, renders the complete straightening of this portion of the spine impossible, and this obliquity makes the action of the muscles which are inserted into them less powerful than in the loins and neck. The ligaments which serve to increase the solidity of the articulation of the vertebræ with each other, are, 1. The interspinous, which occupy the spaces existing between the spinous processes of the dorsal and lumbar vertebræ. 2. The supra-spinous or dorso-lumbar ligaments, the force of which is only remarkable in the loins. 3. The yellow ligaments, which occupy the interlaminar spaces, and complete behind the vertebral canal. These ligaments, as well as the supra and infra-spinous, counteract the flexion of the column forwards, and may be broken when this motion is violent. 4. The posterior vertebral ligaments, which occupy the anterior surface of the spinal canal; and 5. The anterior vertebral ligament, very thick in the back, and thin in the neck and loins, covers all the anterior surface of the spine. These ligaments are opposed to the flexion of the spine backwards; but it is the inter-vertebral substance which acts with the greatest power in preventing this kind of displacement.

§ 127. The articulation of the ribs with the vertebral column, is effected not only by means of small depressions on the lateral parts of the bodies of the dorsal vertebræ which receive the heads of these bones, but by the junction of their tuberosities with the transverse processes of the corresponding vertebræ. The

costo-vertebral articulations, properly called, are fortified by anterior, posterior, and inter-articular ligaments. The costo-transverse articulations present three ligamentous bundles, a posterior, middle, and inferior. There is no well authenticated case of dislocation of the ribs, but this should not astonish us; for, from the length and pliability of these bones, the solidity of their articulations, and the thickness of the muscular layer which covers these last parts, it is evident that they may be more readily fractured than dislocated. The head, or vertebral extremity of the ribs, is supported by a rounded and contracted portion of these bones, which is called their neck, and which terminates at the tuberosity where the costo-transverse articulation takes place. Further, we observe on the outer surface of the ribs, a projecting line, which proceeds downwards and outwards, and its distance from the head of the bone is great in proportion as the ribs descend: it gives attachment to the sacro-lumbalis muscle, and is called the angle of the rib. Lastly, the curvature of these bones is much greater in the dorsal region than in the anterior or lateral portions of the thorax.

The intercostal spaces are much narrower in this region than in the other parts of the chest. The external intercostal muscles extend as far as the spine; but the internal intercostal muscles do not go beyond the level of the angle of the ribs; from which it results that, in this part, the intercostal arteries, instead of being lodged between these two layers of muscles, are immediately in contact with the pleura. These vessels proceed in a serpentine course in the middle of the intercostal spaces, and soon divide into two branches, the superior of which follows the inferior border of the rib which is placed above. (Vide § 113.)

The supra and infra-costales, small bundles of muscular fibres which extend from the transverse processes to the ribs situated below, or from one rib to another, present nothing remarkable. On each side of the vertebral column, we observe, on the internal surface of the head of the ribs, or in the intercostal spaces, the thoracic ganglia and their filaments of communication.

The vena-azygos, thoracic duct, œsophagus, and aorta, lie on the anterior surface of the bodies of the vertebræ. When this artery is affected with aneurism, it often happens that the bodies of the vertebræ are destroyed to a considerable extent. No instance has been known of an opening of the aneurismal sac into the spinal canal; but, as M. Laennec observes, there is nothing to prevent this phenomenon from occurring when the pressure exerted on the anterior part of the column has caused absorption of the corresponding portion of the vertebræ. The depression, which we find on each side of the anterior part of the column, and which is formed by the great curvature of the posterior part of the ribs, is in intimate connexion with the lungs, and it is worthy of remark, that when these organs are affected and compressed by the effect of an effusion of liquid into the cavity of the pleura, it is in this part that the respiratory murmur continues audible for the longest period.

Note.—The posterior dorsal region is not frequently the seat of operations, excepting for the removal of tumours. It was, however, recommended by the late Mr. Henry Cline, in cases of fracture of the vertebræ with depression, to cut down on the depressed parts, and endeavour to raise them. This operation has been performed five times, once by the late Mr. Henry Cline, twice by Mr. Tyrrell, and once by Mr. Wickham of Winchester, and Mr. Oldnow of Nottingham. In all these cases, we regret to say, the operation proved unsuccessful.

Mr. Tyrrell performed his first operation in the following manner:*—" an incision," says Mr. Tyrrell, "about six inches in length, was made through the integuments, in the direction of the spinous processes, having that of the last dorsal vertebra in the middle, over the point of which was observed some slight extravasation of blood. The muscles were then separated by the scalpel from the sides of the spinous processes, and from the arches of the twelfth dorsal and

* *Vide* Sir A. Cooper's Lecture, by F. Tyrrell, Esq. vol. ii. p. 12.

first lumbar vertebræ, as far as the transverse processes, also partially from those above and below. During this separation, some arterial hæmorrhage occurred, which was very troublesome in obstructing my view of the parts; but it was not very copious. An assistant then held aside the integuments and muscles with a broad bent piece of iron, so as to allow of the application of a small trephine on the arch of the first lumbar vertebra. After using the trephine for some time ineffectually, I cut away the spinous process of the vertebræ with a chain-saw, which enabled me to see much better the operation of a trephine; and, finding that I made very little progress with it, I took, instead of it, one of Hey's small saws, with which I sawed nearly through the arch, close to the transverse process; and, after having done the same on the other side, I soon succeeded in removing the larger part of the arch with a pair of strong tooth forceps, leaving but a thin portion, covering the canal. The arch of the twelfth dorsal (over which the extravasation had been observed) was distinctly found to be loose. I then proceeded to remove it, as I had done the former, which I soon effected completely, so as to expose the ligamentum subflavum; this was found divided: on elevating it, the dura matral covering of the cord was seen quite perfect, and apparently free from injury. I then removed the portion of the arch of the first lumbar, which I mentioned as having left, together with the ligament, exposing near two inches of the sheath of the cord, which appeared healthy, and under which the pulsations of the cord could be seen. The patient could now feel distinctly, on being pinched inside the thigh, which immediate return of sensation was beyond my most sanguine expectations. The edges of the wound were brought together by two sutures, dressed lightly with strips of adhesive plaster, and the patient removed to his ward, on the same bed, and in the same position."

The operation was most skilfully performed, but the patient died on the thirteenth day, of inflammation of the bladder. Mr. Tyrrell's second case, which is recorded in *Lancet*, Vol. XI. No. 182., terminated

fatally on the sixth or seventh day, of what was believed to be inflammation of the pleura; the body, however, was not examined.—T.

CHAPTER IX.

REGION OF THE SHOULDER, OR SCAPULO-AXILLARY REGION.

§ 128. We give the name of scapulo-axillary region to the parts situated between the anterior and posterior regions of the thorax and neck on one side, and a circular line, which would surround the arm at the level of the inferior edge of the tendon of the great pectoral muscle on the other side. It comprehends, therefore, the external portion of the subclavicular space, the axilla, the scapulo-humeral articulation, the superior extremity of the arm, the scapulary surface, and lastly, the superior and lateral portions of the parietes of the thorax. At the superior and anterior part of this region we distinguish, across the skin, the scapular extremity of the clavicle, which joins the acromion, and rises externally over a well-defined convexity, belonging to the deltoid muscle, and the head of the humerus, which may be felt across this muscle. On the internal side of the shoulder, is observed a triangular space, bounded by the clavicle and the acromion superiorly, by the coracoid process inferiorly, and by the head of the humerus externally; it corresponds to the scapulo-humeral articulation, and it is important to observe it, for, as we shall hereafter see, it is in this situation the knife is inserted in the operation of amputating the arm at the joint, according to the method of MM. Champesne and Lisfranc. More internally, we perceive still at the anterior part of this region a vertical depression more or less deep, according to the position of the arm, and the degree of obesity in the subject; it corresponds to the space which exists between the lateral part of the thoracic parietes,

and the shoulder, and which constitutes the top of the cavity of the axilla. Inferiorly, the anterior surface of this region is terminated by the edge of the great pectoral muscle, the obliquity of which is great in proportion as the arm is more distant from the trunk. The posterior part of this region presents exteriorly the projection of the spine of the scapula, and of the superior surface of the acromion; a projection, which determines the separation between the fossæ supra and infra-spinatæ. We distinguish also, across the teguments, the axillary edge of the scapula, its inferior angle, and its spinal edge, which serves as a boundary between the posterior regions of the thorax, and scapulo-axillary. Lastly, we observe, below this part, the edge of the great dorsal muscle, which is separated from that of the great pectoral by a deep cavity, when the arm is close to the trunk; but superficial and triangular when this limb is elevated. This is the cavity of the axilla, which is narrow externally, where it commences, at the superior internal part of the arm, becomes wider internally up to the parietes of the thorax, and ceases at the lateral parts of the chest. We can feel the lymphatic ganglia, the head of the humerus, and sometimes the pulsations of the brachial artery.

The integuments which cover the anterior and posterior parts of this region are, in general, smooth, somewhat thick, and of a firm texture: under the axilla the skin is much softer, and more capable of extension; its texture is less firm; it is covered more or less abundantly with hair, and contains a great number of sebaceous follicles, which secrete a sharp, strong-smelling fluid, especially in women and red-haired individuals.*

* The author might have added, "individuals of the negro race," in whom the odour emitted by the sebaceous glands of the axillæ is of an insupportable fetor. Horace seems to have possessed the faculty of detecting this unpleasing peculiarity in the human female with the sagacity of a pointer:—

——————— "sagaciùs unus odoror,
Polypus, an gravis hirsutis cubet hircus in alis,
Quàm canis acer, ubi lateat sus."

Epod. xii. *in Anum fœtidam.*—T.

Immediately under the skin is found a layer of cellular tissue of some thickness. Below the acromion it presents the appearance of a true bursa mucosa; in the points at which the bones project under the integuments, it is thick, and devoid of fat; in the other parts it contains a quantity of adipose tissue, more or less considerable according to the degree of obesity in the subject. Fat accumulates more readily above the deltoid muscle, and at the anterior and superior part of that region, than at its posterior part. This subcutaneous layer is more adherent to the integuments than at the parts situated below it; accordingly, it is, in general, easy to bring in contact the edges of a wound which affects only those parts, even when the loss of substance is considerable. In the cavity of the axilla we find a very great quantity of cellular tissue, more loose than in the rest of this region, and affording attachment to a considerable number of lymphatic ganglia.

The *cephalic vein*, which rises vertically at the external and anterior part of the arm, lies more or less deeply in this subcutaneous cellular tissue, according as the sulcus formed by the junction of the deltoid, and great pectoral muscles, is superficial or deep. At the level of the clavicle this vessel makes a curve internally, and passes above and below this bone to open into the axillary vein. In the other parts of this region, the veins and arteries which run among this subcutaneous layer, present nothing remarkable.

Between this layer of cellular tissue, and the muscles situated below, we find a fascia, which is continued with the brachial aponeurosis; in general, this membrane is of a whitish appearance only below the inferior point of its attachment to the deltoid muscle, and resembles in the rest of its course a layer more or less distinct of condensed tissue; sometimes, however, it is of considerable thickness and strength, resembling a true aponeurosis through the whole course of the scapulo-axillary region. Superiorly, it is attached to the clavicle, and the scapulo-humeral articular capsule; internally, it is continued with the cellulo-aponeurotic layers, of which we have spoken in the preceding chapters. The existence of this membranous layer explains

why the collections of matter, which form in this part, present such remarkable differences. In fact, when they are situated between it and the skin, they always tend to make a passage towards the surface, whereas, when they are situated more deeply, they tend, on the contrary, to penetrate into the axillary cavity.

§ 129. At the anterior part of this region we find, below the parts we have just described, the great pectoral muscle, of which the third part is situated in the anterior thoracic region (§ 105). The fleshy fibres which are attached to the clavicle, run somewhat obliquely, externally, and inferiorly, forming a bundle thick and distinct from the rest of the muscle. The lowest fibres, which are also the longest, rise, on the contrary, very obliquely, and towards their external extremity pass under the superior ones; hence, this part of the great pectoral is narrow and very thick, while the internal portion is thin and very broad. The species of tendon, by which it is terminated, is very broad, and folds on itself; it is inserted into the anterior edge of the bicipital groove, and sends an aponeurotic prolongation to be continuous with the tendon of the infraspinatus muscle upon the great tuberosity of the humerus. The superior edge of this muscle descends obliquely from the clavicle to the humerus, and is contiguous to the deltoid, and to the cephalic vein; its inferior edge, thin internally, round and thick externally, forms the anterior edge of the cavity of the axilla. Its posterior surface is fringed by a thick cellular tissue, which is continued with the superficial fascia, and with the cellular tissue of the axilla; it here covers the external extremity of the subclavius, the axillary vein and artery, the nerves of the brachial plexus, the small pectoral muscles, the long portion of the brachial biceps, &c. It is to spare this muscle, that, in the operation of tying the axillary artery below the clavicle, according to the method of M. Marjolin, an incision is made parallel to the direction of its fibres, beginning below the clavicle, opposite the external edge of the sterno-mastoidean.

§ 130. The *subclavius* is situated under the inferior edge of the clavicle, and is prolonged to the acromial

extremity of this bone, passing under the anterior edge of the deltoid. The internal portion of this muscle is covered by an aponeurotic expansion, which is attached to the external surface of the clavicle, and the coracoid process towards the first ribs; its posterior and inferior surface is in immediate contact with the nerve and axillary vessels; the presence of this muscle between these parts and the clavicle must contribute greatly to diminish the pressure of this bone on the nerves of the brachial plexus and upon the second rib, which is placed behind them, when the arm is carried violently backwards. This structure also explains why, in cases of fracture of the clavicle, the artery and nerves which pass below are never wounded by the fragments of this bone.

§ 131. The *pectoralis minor* is separated from the *pectoralis major* by a layer of adipose cellular tissue of some thickness, and by branches of the thoracic vessels and nerves. It is thin, flattened, of a triangular shape, and is attached by its base to the third, fourth, and fifth ribs; from thence its fleshy fibres rise, converging externally and posteriorly, to terminate by a tendon which is continuous with those of the coraco-brachial and biceps muscles, and is attached to the coracoid process of the scapula. The posterior surface of this muscle is placed upon the ribs, the external intercostal muscles and serratus magnus, the axillary vessels, and nerves of the brachial plexus. The superior edge of this muscle leaves between it and the clavicle a space filled by some loose cellular tissue, at the bottom of which are seen the larger vessels, of which we have already spoken. The inferior edge of the *pectoralis minor* is longer and more oblique than the superior.

§ 132. The *axillary vein*, the continuation of which is called the subclavian, rises obliquely inwards along the anterior and internal part of the arm, and passes under the clavicle to the superior part of the space comprehended between this bone and the *pectoralis minor;* it receives there, in general, the cephalic vein, is placed upon the two first ribs, the first external intercostal muscle, and the inferior extremity of the serratus magnus, and covers more or less completely the ax-

illary artery with which its superior and external surface is in contact. Behind and below the pectoralis minor the axillary vein is placed before and within the artery from which it is separated by the median and cubital nerves; the internal cutaneous nerve descends sometimes before, sometimes behind, or upon the sides of that vessel, which arises between the internal tuberosity of the humerus and the tendon of the pectoralis major, and is formed by the junction of the brachial and basilic veins. The latter is again formed by the median basilic, posterior and anterior cubital veins. Lastly, the axillary vein receives, in the course of its passage under the pectoralis minor, the thoracic acromial veins, &c., vessels which follow the course of the arteries of the same name, and present nothing remarkable.

§ 133. The *brachial plexus*, which is situated behind and without the subclavian vessels, during their passage between the external edge of the scalenus and the clavicle, maintains nearly the same relation to the top of the axillary space; but in passing under the pectoralis minor, it is divided into many branches, which surround the artery, and form a sort of sheath to it. The *anterior thoracic nerve*, comes off from the anterior part of the plexus, above the clavicle, passes under this bone, and before the axillary artery, and is divided into a great number of branches, of which the greater part are distributed to the anterior surface of the thorax. The branches by which the plexus is terminated below the pectoralis minor are, 1st, the internal cutaneous brachial, which descends vertically along the internal surface of the arm, and of which the size is inconsiderable; 2ndly, the external cutaneous brachial, which soon separates into two branches, one of which passes before the axillary artery to assist in the formation of the median nerve, and the other descends obliquely outwards behind the coraco-brachial muscle; 3dly, the median, formed by the branch of which we have spoken, and by the junction of the sixth and seventh cervical nerves and first dorsal, and placed without the artery behind the internal surface of the biceps muscle; 4thly, the cubital, which descends almost vertically along the

internal edge of the same muscle, passing off from the artery; 5thly, the radial, which runs obliquely downwards and backwards between the biceps and humerus; and 6thly, the axillary or circumflex.

§ 134. The axillary artery is the continuation of the subclavian, which we have seen pass under the clavicle and the subclavian muscle, after having crossed the little triangular space situated between this bone, the anterior scalenus, and the nerves of the brachial plexus (§ 87.) It takes an oblique direction downwards and outwards, describing a curve, of which the convex surface is turned outwards and upwards, and takes the name of the brachial artery, when it arrives below the internal edge of the latissimus dorsi. Immediately after passing under the subclavius muscle, the axillary artery is only separated from the latissimus dorsi by the aponeurotic layer, which extends from the coracoid process to the ribs, and by a layer of adipose cellular tissue. It is situated on the outer side and a little behind the vein of the same name; accordingly, although in the dead subject it is not concealed by this last vessel, it is otherwise in the living subject; for, in the act of expiration, the vein swells, and is extended upon the artery. Hence, in the operation of tying the axillary artery at this point, we are often obliged to draw the vein to the inner side. The outer side of this vessel is connected with one of the nerves of the brachial plexus, which covers it more and more as it descends; its posterior side is equally in contact with this plexus; its internal side is first lodged in a sulcus afforded by the superior surface of the first rib, and is afterwards connected with the first external intercostal muscle, the second rib, and the superior extremity of the serratus magnus. During its passage under the pectoralis minor, the axillary artery, instead of being placed within the brachial plexus, is completely surrounded by the nerves which pass off from it, and which form a sort of sheath round this vessel. Hence, when we wish to tie the axillary artery towards its superior part, it is always in the space comprehended between this muscle and the inferior edge of the subclavius that the operation should be performed. According to Hodgson's

method, a semi-lunar incision is made into the teguments and the *pectoralis major*, beginning at the distance of about an inch from the sternal extremity of the clavicle, and ending near the anterior edge of the deltoid muscle; the flap is then raised, and the cellular tissue which unites the artery to the vein and nerves is torn with a blunt instrument. According to Marjolin's method, the edges of the wound, of which we have already pointed out the direction (§ 129,) are separated, a pointed probe is introduced between the vein and the artery, and is drawn between this vessel and the nerves of the plexus, care being taken not to include in the ligature the nervous filaments which pass in front of this vessel. The artery, being contiguous to the nerves of the plexus, may communicate to them a pulsatory motion, and it might therefore be mistaken for one of these filaments; hence it is necessary, before finally tying the artery, to ascertain that this vessel is really the part tied. It is at the superior part of the space situated between the *pectoralis minor* and the subclavius, that the axillary artery is least covered by the vein and nerves; but at this point it is crossed by the cephalic vein, the ligature must, therefore, be placed between this space; for, lower down, besides the inconvenience we have mentioned, we should be liable to come in contact with the origin of the acromial arteries, the anterior thoracic, &c. After the obliteration of the axillary artery at the point we have mentioned, it is chiefly by the aid of the numerous anastomoses between the transverse cervical, scapular, internal mammary, acromial, thoracic, inferior scapular, circumflex, &c., arteries, that the blood enters into the brachial artery, and the circulation is continued in the diseased limb.

During its passage under the pectoralis minor, the axillary artery is connected anteriorly with the biceps, coraco-brachialis, and pectoral muscles; and posteriorly with the sub-scapular. After passing the lower edge of the pectoralis minor, it corresponds anteriorly to the tendon of the pectoralis major, to the biceps, and the coraco-brachialis; outwards to the humerus, inwards to the brachial aponeurosis and the teguments, and backwards to the tendons of the sub-sca-

pular and the latissimus dorsi. During its passage, this vessel gives origin to the sub-scapular and circumflex arteries, and is covered within by a layer of cellular tissue of some thickness. It is evident, that if we wished to tie the axillary artery in this part of the arm, the operation would be easy, provided we kept the limb sufficiently extended from the body; for then, in order to expose this vessel, we should only have to divide the integuments, the aponeurosis, and some cellular tissue along the internal side of the inferior edge of the pectoralis major; but it would not be easy in the contrary case, for we should be obliged to cut the fibres of this muscle across. As to the pressure which might be made upon the artery, it would certainly be easy, in consequence of the resisting surface which the humerus offers on the external side of this vessel; but as we should compress, at the same time, the greater part of the nerves of the arm, serious consequences might ensue.

From what we have said on the relation existing between the axillary artery and the nerves of the brachial plexus, it is evident that, in the case of gun-shot wounds, this vessel cannot be wounded without the nervous filaments, which cover it, partaking in the injury: hence, if in a case of this nature the hæmorrhage be very considerable, without its being clear that the axillary artery or the subclavian have been opened, the absence or presence of paralysis, and of the loss of feeling in the parts where these nerves take their course, will throw considerable light upon the diagnosis. This consideration is equally important when the axilla is the seat of a gun-shot wound, which is not accompanied with much loss of blood; for it often happens, in cases of this kind, that the ball, in its passage, destroys the neighbouring parts, and forms an eschar, which, when it separates, produces a hæmorrhage, which either destroys life immediately, or is attended with serious consequences. But if the artery be thus affected, the nerves which cover it must, *à fortiori*, be equally affected, and the symptoms to which we have alluded will take place, and admonish the surgeon that the separation of the eschar will probably be attended with serious consequences, unless he prevent them by applying a ligature.

§ 135. At the upper portion of this region above the parts which we have described is found the *deltoid* muscle, which forms the projection called the round part of the shoulder; it is attached on one side to the anterior surface of the scapular extremity of the clavicle, to the acromion, and to the inferior edge of the spine of the scapula, and on the other, to the superior surface of the humerus immediately below the insertion of the tendon of the pectoralis major. Its superior surface is convex, and connected to the inferior extremity of the platysma myoides, and the superior portion of the great aponeurosis which separates it from the integuments. Its inferior surface is concave and covers the inferior extremities of the subclavius and two pectoral muscles, the superior extremities of the coraco-brachialis, biceps, coracoid process, the coraco-acromial ligaments, the articulation of the shoulder, the tendon of the infra-spinatus: the supra-supinatus, subscapularis, triceps, together with the upper third of the humerus, and the circumflex vessels and nerve, are also covered by it. Between this muscle and the capsule of the joint a bursa mucosa of considerable size is situated. In the remainder of its extent the inferior extremity of the deltoid is united to the bone by very loose cellular tissue. It is in consequence of this arrangement that we so frequently observe effusions of blood in this part from violent contusions and fractures of the neck of the humerus; it also accounts for the ease with which matter lodged in this part escapes to other parts distant from the joint. At its upper part the anterior edge of the deltoid is separated from the pectoralis major by a hollow space filled with cellular tissue and lodging the cephalic vein; inferiorly, it is in connexion with the biceps. Its posterior edge extends obliquely from the internal part of the spine of the scapula to the upper third of the humerus: its superior part is thin and continuous with the aponeurosis covering the trapezius and supra-supinatus, in the rest of its extent it is thicker, and joined by cellular tissue to the supra-spinatus, teres major and minor, and triceps muscles.

§ 136. The *acromial artery* arises from the axillary on a level with the superior edge of the pectoralis mi-

nor, and proceeds obliquely outwards beneath the pectoralis minor. Arrived at the anterior edge of the deltoid, it divides into two branches; the one, superior, mounts towards the clavicle, in the space which exists between the pectoralis major and deltoid, sends a branch to this last muscle, and then terminates on the extremity of the clavicle, and on the capsule of the joint; the inferior follows the course of the cephalic vein, and is distributed to the deltoid and pectoralis major muscles. In order to avoid this vessel, in the operation of tying the subclavian below the clavicle, it has been recommended not to approach too near to the edge of the pectoralis minor. In amputation of the arm, at the shoulder joint, according to Champesne and Lisfranc, the superior portion of the acromial artery is necessarily divided in making the upper flap.

§ 137. At the posterior and superior part of the region we are now describing, we find the external extremity of the trapezius muscle, which is attached to the superior portion of the clavicle, acromion and spine of the scapula. Here it covers the supra and infra-spinati, and the extremity of the spine of the scapula, from which is is separated by a layer of thin cellular tissue.

The posterior surface of the *supra-spinatus muscle* is covered directly by a thin aponeurosis, which is attached to the spine, base, and superior edge of the scapula, and is continuous anteriorly with the scapulo-clavicular ligaments. The fibres of this muscle are kept in their situation by this aponeurosis, and are attached to its posterior part, as well as to the two internal thirds of the fossa-supra-spinata of the scapula: on a level with the coraco-acromian ligament they terminate by a tendon, which passes beneath this ligament, and goes to be attached to the greater tubercle of the humerus. Between the anterior surface of the supra-spinatus, and the fossa in which it is lodged, we find several branches of the *scapular artery*, which we have described as arising from the subclavian or inferior thyroid behind and below the clavicle (vide § 86.) Arrived at the upper edge of the scapula, this vessel passes into a groove, formed into a foramen by the coracoid ligament, and enters into the fossa-supra-spinata; it

then takes a course outwards, and bends on the edge of the spine of the scapula to terminate in the fossa-infra-spinata. It presents nothing interesting in a surgical point of view. This is also the case with the subscapular nerve, which comes from the superior and posterior part of the brachial plexus, and takes the same course as the scapular artery.

The *latissimus dorsi* covers the inferior part of the fossa-infra-spinata proceeding obliquely from below upwards, and from within outwards towards the superior third of the humerus, and forming, with the *teres major*, the posterior boundary of the axilla. This last muscle, of a flat and elongated form, arises from the inferior part of the external surface of the scapula, and from its anterior edge; and terminates in a tendon common to it, and the lastissimus dorsi, which is inserted into the posterior edge of the bicipital groove. A small aponeurotic layer descends from the lesser tubercle of the humerus in front of the tendon, and keeps it close to the bone. The outer portion of the latissimus dorsi, at its back part, is covered by integuments, and is connected by its tendon to the superior and internal part of the humerus. The posterior surface of the teres major is covered by integuments, humerus, and the long portion of the biceps. The anterior surface of the latissimus dorsi covers the serratus magnus, teres major, infra-spinatus, and inferior angle of the scapula; that of the teres major is in connexion with the subscapularis, coraco-brachialis, and biceps; their united tendon is contiguous to the axillary vessels and to the brachial plexus.

§ 138. The *infra-spinatus* muscle is lodged in the fossa-infra-spinata of the scapula. Its posterior surface is covered by a thin aponeurosis, which is attached to the scapula, and externally to the fibrous capsule of the joint, whence it becomes continuous with the brachial aponeurosis. The fleshy fibres of the infra-spinatus arise in part from the anterior surface of this aponeurosis, but chiefly from the fossa-infra-spinata, whence they converge towards the head of the humerus, to be inserted into the larger tubercle of the humerus. The surface of this muscle is connected with the

trapezius internally, the latissimus dorsi inferiorly, the integuments in the centre, and the deltoid externally. The *teres* minor, frequently united to the former, is attached to the scapula, near its axillary or anterior edge, and to the internal surface on the greater tubercle of the humerus. It is connected with the integuments and deltoid by its posterior, with the external scapular artery, the long portion of the triceps and the capsule of the joint by its anterior surface. The triceps, to which we shall return in the following chapter, is attached to the axillary edge of the scapula to the extent of about an inch, immediately below the glenoid cavity, and in this way separates the external portion of the two teretes.

The *scapular artery* arises from the axillary behind the brachial plexus opposite to the inferior edge of the tendon of the subscapularis muscle, and soon divides into two considerable branches: the one, inferior, descends along the external edge of the scapula to be distributed to the neighbouring muscles; the other, superior and larger, takes a course from before backwards beneath the latissimus dorsi, and terminates in the fossa-infra-spinata.

§ 159. The *subscapularis* is attached to the lesser tubercle of the humerus by a thick tendon, which firmly adheres to the capsule of the joint. From thence its fleshy fibres proceed backwards and inwards to terminate on the three internal fourths of the subscapular fossa. The posterior surface of this muscle is in connexion with the scapula, the teres major, the long portion of the triceps and the capsule of the joint; its anterior contributes to form the axilla. Internally, it is separated from the serratus magnus by a layer of thick cellular tissue, externally, it corresponds to the brachial plexus, the axillary artery, and the coraco-brachialis, biceps, and deltoid muscles.

The biceps is divided superiorly into two portions, the largest and most external of which is attached to the upper part of the glenoid cavity, the other to the coracoid process, in conjunction with the coraco-brachialis. The part of the biceps situated in this region is covered by the deltoid and pectoralis major, and

rests on the humerus and the coraco-brachialis; the axillary artery rests against its internal edge. The coraco-brachialis, situated at the upper and inner part of the arm, is attached superiorly to the extremity of the coracoid process, between the short portion of the biceps and the pectoralis minor; it then descends beneath the deltoid, pectoralis major and biceps, and is in connexion posteriorly with the subscapularis muscle and the tendons of the latissimus dorsi and teres major, and with the axillary artery, and terminates about the middle of the humerus.

§ 140. The *posterior circumflex artery*, which arises from the back part of the axillary, below the head of the humerus, turns round the bone, passing horizontally backwards between the subscapularis and teres major, in front of the long portion of the triceps, and beneath the deltoid, to the anterior and external part of the humerus, where it is distributed to this muscle and the neighbouring parts. Sometimes this vessel gives off the *anterior circumflex artery*, but it generally comes from the axillary; in either case it goes horizontally forwards and inwards, beneath the coraco-brachialis and the short portion of the biceps, along the superior edge of the tendon of the latissimus dorsi and teres major; it then makes a curve between the deltoid and humerus, passing beneath the tendon of the long portion of the biceps, to be distributed to the substance of the deltoid and the joint. The *circumflex nerve* arises from the internal and posterior part of the brachial plexus or radial nerve, passes in front of the subscapularis, and dips down between the teres major and minor. It then takes a course from before backwards, and from within outwards, between the long portion of the triceps and the capsule of the joint, to reach the posterior edge of the deltoid. Paralysis of the deltoid, which takes place in certain cases of dislocation of the scapular extremity of the humerus, depends on compression of this nerve. In fractures of the neck of this bone, the circumflex nerve, as well as the circumflex vessels, may be torn through; and in the amputation at the shoulder joint, these parts must necessarily be divided.

§ 141. Beneath the soft parts which we have just enumerated, we come to the bony structure of the shoulder, formed by the clavicle, scapula, and superior extremity of the humerus. The scapula, which is the most considerable of these bones, extends on the lateral and upper portions of the thorax, from the first to the seventh rib. It is thin, flattened, and of a triangular form; its posterior or dorsal surface is divided into two parts by the spine of the scapula, a triangular eminence, situated transversely towards the upper third of the bone. The spine commences at the posterior edge of the bone by a triangular surface, on which the aponeurosis of the trapezius slides; it becomes more and more prominent on advancing towards the external edge of the scapula, and at last terminates in a considerable eminence called acromion. The portion of bone above the spine is called the fossa supra-spinata, the one below it the fossa infra-spinata. The *acromion*, or outer termination of the spine of the scapula, is flattened from before to behind: its external surface is convex, and covered by the common integuments; its internal is concave, and covers the scapulo-humeral articulation; and lastly, its superior edge is turned a little inwards, having an oval surface for articulation with the clavicle. The point of the acromion remains cartilaginous to the age of fourteen or fifteen years, or even longer, and its length is such, that the ossified portion on which it rests does not advance but one or two lines on the superior extremity of the arm, whilst the point of the process, which at a later period becomes completely ossified, forms a projection from eight to nine lines beyond the glenoid cavity. It is partly in consequence of this arrangement that M. Lisfranc has proposed, in amputation at the joint, instead of carrying the instrument between the acromion and head of the humerus, to introduce it into the joint, to divide directly across the cartilaginous portions of this eminence and the neigbouring part of the clavicle. The length of the acromion, the narrowness of the spine which supports it, and lastly, its superficial situation, account for this process being frequently fractured towards its base. In cases of this kind, the external fragment is drawn

downwards by the action of the deltoid muscle and the weight of the arm, and is consequently separated from the rest of the bone. To relieve this accident, the arm should be placed by the side of the trunk, and raised parallel to its axis, in order to prevent the action of the deltoid, and place the acromion on a level with the spine of the scapula, by pushing it from below upwards with the head of the humerus.

The posterior edge of the scapula gives attachment to the supra and infra spinati muscles, serratus magnus, and rhomboidei; its superior or cervical edge serves for the insertion of the supra-spinatus, the subscapularis, and omo-hyoideus; towards its external part, it presents a groove, which is converted into a foramen by a ligament, and which gives passage to the subscapular vessels and nerve. Externally, this edge terminates in a narrow elongated process, called the coracoid process, which makes a slight bend from behind forwards. Its apex serves for the attachment of the short head of the biceps and coraco-brachialis; its anterior edge for that of the pectoralis minor. The posterior edge gives attachment to the acromio-coracoid ligament, which is inserted by its apex into the extremity of the acromion process. This ligament assists, with the acromion and coracoid process, in forming a kind of protection over the head of the humerus, by which the dislocation of this bone upwards without fracture is rendered impossible. The deep situation of the coracoid process must necessarily render fracture of this part rare, but instances of this kind sometimes occur.* When this accident happens, the fractured process is drawn downwards by the action of the pectoralis minor, coraco-brachialis, and biceps, and it is a matter of considerable difficulty to keep the detached portion of bone in its proper situation.

The external or axillary edge of the scapula is inclined downwards and forwards, and forms at its pos-

* The student should bear in mind, that the coracoid process is situated about three quarters of an inch to the inner side of the head of the humerus, and that it may be readily felt, even in fat persons, by placing the finger at this situation in a kind of hollow space left between the deltoid and pectoralis major.—T.

terior edge a thick and rounded angle, to which some fibres of the latissimus dorsi are frequently attached. This edge, thicker than the two others, then gives attachment to the teres major, subscapularis, teres minor, and triceps; at its upper part it presents a thick truncated eminence, supported by a kind of neck, and intercepted by an articular cavity called the glenoid. This cavity, which receives the head of the humerus, is very superficial, and shallower above than below; it is oval, the greatest diameter being vertical, and slightly inclined downwards and outwards. Lastly, it is covered by cartilage and a fibro-cartilaginous ring, which increase its depth.

The anterior or costal surface of the scapula is concave, and is called the fossa-subscapularis. It is inclined inwards, and gives attachment to the subscapularis and serratus magnus, which separate it from the ribs. The deep situation of the scapula, the thickness of the mass of muscles by which it is enveloped, and its extreme mobility, render fractures of this bone, particularly those of its body, very rare. In fact, this accident can only be produced by some violent force acting directly on the part; the fracture may then be longitudinal or horizontal, or the bone may be broken to pieces. If the solution of continuity be vertical, (which is rare), no displacement takes place; for the two portions of the bone are equally kept in their place by the muscles which are inserted into them. If, on the contrary, the fracture be a transverse one, the lower fragment is drawn forwards and downwards by the action of the serratus magnus, and forwards and upwards by that of the teres major and latissimus dorsi, in proportion to the distance of the seat of the injury, from the inferior angle of the bone.

§ 142. We have already described the internal portion of the clavicle, and its articulation with the sternum (§ 109.); it now remains to consider its scapular extremity, which is large, flattened, and inclined backwards and upwards. We observe on it an oblong narrow surface, directed obliquely from without inwards and below upwards, and covered with cartilage, for articulation with the acromion. Two ligaments, a su-

perior and inferior, cover the whole of the articulation. At the posterior and inner part of this articulation, another ligament is situated, called the conoid, and fixed by its apex to the posterior part of the coracoid process, and by its base to the inferior surface of the clavicle. Another fibrous bundle, which is also attached to the coracoid process and the clavicle, is situated nearer the articulation; this is the trapezoid ligament: it is of a quadrilateral form, and takes an oblique course from below upwards and from within outwards. Joined to the preceding by its posterior edge, it forms a triangular cavity, filled with cellular tissue and the subclavius. These ligaments are sometimes known by the name of external and internal coraco-clavicular ligaments. Not unfrequently, there is a third coraco-clavicular ligament found attached to the anterior edges of the coracoid process and of the clavicle, at the centre of its middle curve. Its superior surface corresponds to the triangular space between the deltoid and pectoralis major; the inferior rests on the subclavian muscle and the axillary artery and vein.

It is owing to the arrangement of the different ligaments which we have been describing, that there is no deformity in fractures of the clavicle between the acromion and coracoid process. Dislocation of the acromial extremity of the clavicle is very rare, and can only happen when the ligament surrounding the articulation has been ruptured, as well as those which join the clavicle to the coracoid process.

§ 143. The superior extremity of the humerus is the largest part of the bone. It has a globular form, and presents three distinct eminences, to which the names of head and greater and lesser tubercles have been given. The largest of these eminences, the head, is situated above the two others: it has nearly an hemispherical form, and is inclined upwards, inwards, and backwards. It is smooth, surrounded with cartilages for articulation with the glenoid cavity of the scapula, and circumscribed by a contraction which is more evident on its fore, lower, and inner, than its upper and outer part, and is termed, anatomically, the neck of the humerus; its axis forms an obtuse angle with the

rest of the bone. The greater tubercle is situated at the back part of the humerus, and presents three surfaces, which serve for the insertion of the tendons of the supra and infra-spinati and teres minor. The lesser is separated from the greater tubercle by the commencement of the bicipital groove, and gives attachment to the tendon of the subscapularis.

The scapulo-humeral articulation is an enarthrosis, but the extent and the depth of the glenoid cavity are not in proportion to the size of the head of the humerus. Hence, the greatest part of this eminence is situated external to the articular cavity, although the size of the cavity is increased by the fibrous band which surrounds its edges, and appears principally formed by the bifurcation of the tendon of the long head of the biceps. The *fibrous capsule*, which surrounds the articulation, and which is the principal band uniting the two bones, is attached superiorly to the neck of the glenoid cavity, and inferiorly round the neck of the humerus, an opening being left at the edges of the bicipital groove for the passage of the tendon of the biceps. Inferiorly, this capsule is very thin, but superiorly and posteriorly its thickness and strength are increased by the tendons of the three muscles inserted into the greater tubercle. Superiorly, it is strengthened by the *coraco-humeral ligament*, a fibrous bundle attached to the outer edge of the coracoid process and the greater tuberosity of the humerus. Externally, it is separated from the acromio-coracoid ligaments by a synovial membrane. Lastly, on its inner side it is quite interrupted for the passage of the subscapularis muscle. The looseness of the capsule is such as to allow a separation to nearly the extent of an inch between the articular surfaces; from which cause dislocation of the humerus is very common after paralysis of the muscles of the shoulder, when they become no longer able to keep the head of the humerus against the glenoid cavity. The cases related by Sir A. Cooper show the power of this muscular influence: for, in cases of paralysis of the muscles of the shoulder, he has seen dislocation produced by the mere weight of the limb, each time that the hand was carried towards

the head. Dislocation of the scapular extremity of the humerus may take place forwards and backwards, but not upwards, excepting in a consecutive manner. Dislocation downwards is the most frequent, although the elevation of the arm may be carried to a great degree, without the head of the humerus being entirely removed from the glenoid cavity, owing to the vertical direction of the great diameter of this articular surface. It appears that the contraction of the muscles is sufficient to produce this accident; but, in general, it depends on their action joined to that of an external violence, which is most frequently communicated to the elbow during its separation from the body, and whilst it is resting on a solid surface. In fact, if, in a case of this kind, the pectoralis major, latissimus dorsi, and teres major contract with force, they would not move the elbow, as this part rests on the ground, and, consequently, the superior extremity of the humerus would become the moveable point on which they act. The humerus would then represent a lever of the third order, the fulcrum being the elbow, and the point of resistance the scapulo-humeral articulation, a lever, the action of which is great in proportion as the moving power is placed near to the moveable point. In dislocations from muscular power alone, it is the deltoid which, during its contraction, represents the fulcrum of this lever, and the pectoralis major, latissimus dorsi, and teres major, act as the moving powers. It is thus evident, that this displacement is much more difficult of reduction, for, in this case, the length of the arm of the lever from the power is equal to the distance which separates the point of attachment of the deltoid from that of the pectoralis major, whilst in the preceding case it is equal to the whole of the distance which exists between the insertion of this muscle and the extremity of the elbow. When the head of the humerus thus escapes by the inferior part of the glenoid cavity, it rests on the anterior edge of the scapula, between the tendons of the long portion of the triceps and the subscapularis muscle, so that it cannot afterwards be displaced, excepting inwards, which is not

unlikely to happen, in consequence of the obliquity and narrowness of the edge of the scapula.

Dislocation of the humerus forwards is much less frequent than that downwards, although it is not difficult to carry the arm sufficiently far backwards, for this bone to form an acute angle with the glenoid surface. The rareness of this accident appears principally to depend on the arrangement of the subscapularis muscle, and the pectoralis major and latissimus dorsi, &c., which can scarcely contribute to this kind of displacement, on account of their direction to the bone. Dislocation backwards has been observed; but this is more rare, for the trunk can scarcely allow the arm to be carried sufficiently forward for the articular surfaces to be inclined one on the other, so as to form an acute angle.

The amputation of the arm at the joint is one of the most serious operations in surgery. Since the time of Le Dran, different plans have been proposed. From the caliber of the artery, it is evident that this vessel must be either tied or compressed before the operation be commenced; with this view Le Dran passed a strong ligature between the artery and bone at the anterior part of the axilla, and thus compressed not only the vessel, but all the soft parts in the neighbourhood; but M. Dupuytren and most modern surgeons only divide the vessel in the last stage of the operation, and, consequently, any other precaution than the mere compression of the vessel with the finger is quite unnecessary. The number of plans proposed for the performance of an operation which is not of very frequent occurrence, exceeds all belief; but there are two in general use, the one where a superior and inferior flap are formed, the other where two lateral ones are preferred. In most of the cases where the flap above and below is formed, the incision is not carried beyond the coracoid process anteriorly, or the point diametrically opposed to it posteriorly. Hence it follows, that the glenoid cavity is situated in an excavation which becomes the most depending part of the wound, when the patient is situated on the back. But the methods proposed by MM. Champesne and Lisfranc, do not present the same

objection; the incision is carried on each side as far as the glenoid cavity and its posterior edge, and continued much nearer the axilla than in the other modes which have been recommended; two flaps are then formed, the one superior and posterior, the other anterior and inferior. They both rest directly against each other, and allow of the easy exit of the matter. In this operation the instrument is introduced in the triangular space situated between the scapular extremity of the clavicle, the acromion and coracoid process, and is directed so as to pass beneath the acromion, and to come out at the posterior edge of the axilla, about half an inch from this eminence. The surgeon then continuing the incision from before backwards, twists the superior and posterior part of the head of the humerus, and gives to the knife nearly an horizontal direction, so as to completely divide the integuments close to the insertion of the deltoid, and thus forms the superior flap. It is essential to carry the belly of the knife so as form with the axis of the shoulder an angle of 45°; for if it were parallel to the axis of the limb, the operator would run the risk of not opening the capsule: and if it were perpendicular, it is true that the capsule, as well as the tendon of the supra-spinatus and a very large portion of the tendons of the infra-spinatus and subscapularis, would be divided; but in order to form the posterior and superior flap, the direction of the instrument must be changed, and in this way two incisions would be formed nearly at right angles to each other. If, during this part of the operation, the elbows, instead of being approximated to the trunk, be separated from it. and the limb kept in a state of abduction, the head of the humerus would be lodged almost entirely in the axilla, and the great tubercle be drawn so near the acromion, that merely a small portion of the capsule would be divided, and the instrument would strike against the tubercle. If the arm were carried forwards, the tendon of the infra-spinatus would not be divided, and posteriorly the tendon of the infra-spinatus would be left untouched, thus rendering the formation of the inferior flap extremely difficult. In fact, if the operator simply di-

vide the deltoid muscle and coraco-acromion ligament, and destroy the adhesion existing between the inferior surface of the acromion, and the contiguous extremity of the clavicle, and the capsule with the tendons attached to it, the head of the humerus will not be separated more than an inch from the acromion, whilst it may be separated double the distance, if the tendon of which we have been speaking, and the corresponding portion of the capsule, be also divided. The superior flap being made, the knife is then passed behind the head of the humerus, and carried along the inner side of the humerus to the middle of the arm. Previous to completing the section of the flap, the operator takes hold of the skin of the axilla between the thumb and four fingers, so as to compress the axillary artery, which is not tied till the limb is removed from the trunk.

In young subjects the head of the humerus is formed of an epiphysis which is not united to the rest of the bone till later in life, and hence the ease with which this part of the bone is fractured. We have already mentioned that the contracted part of the bone, which separates the head from the tubercles, is called, anatomically, the neck of the humerus; but surgically speaking, by the neck of the bone, we understand that part situated between the tubercles and the insertion of the pectoralis major, latissimus dorsi, and teres major. This portion of the bone is round and smooth, and is not marked by the attachment of any muscles: if the fracture be situated in this part, union is easily effected; but if, on the contrary, the anatomical neck be broken, union will be more difficult; for it is probable that the fragment would not contribute to the formation of the neck, but act as a foreign body in the interior of the capsule. If the fracture be situated in the surgical neck of the bone, the upper portion will be carried outwards by the action of the supra and infra-spinati, and teres minor, and the lower be carried inwards by the contraction of the pectoralis major, latissimus dorsi, and teres major. If this displacement were so great that the ends of the bone were no longer in apposition, the lower portion would be carried upwards by the action of the coraco-brachialis, biceps, deltoid, and tri-

ceps, which would tend to shorten the arm, their direction being parallel to that of the humerus. From this it is evident, that the lower fragment might compress and even lacerate the axillary vessels and nerves; the situation of the vessels and circumflex nerves also exposes them to be wounded in cases of this kind.

In this part of the humerus we observe the bicipital groove, which commences between the tubercles, and lodges the tendon of the long head of the biceps. The pectoralis major is attached to its anterior edge, and the united tendons of the latissimus dorsi and teres major are inserted into its posterior edge. Lastly, towards the upper third of the humerus, on its outer surface, a rough eminence is situated, which serves for the insertion of the deltoid. From this arrangement of the muscles, we perceive that if a fracture of the humerus were situated between the points where the deltoid and pectoralis major and latissimus dorsi are inserted, the upper portion would be carried internally towards the trunk, whilst the lower would be drawn in a contrary direction.

§ 144. The internal edge of the arm-pit has a convex form, and corresponds to the parietes of the thorax. It is formed by the five or six first ribs, the corresponding intercostal spaces, and the *serratus magnus*, which is continued along the superior and posterior parts of the chest. This muscle, large and flattened, is attached posteriorly to the spinal edge (base) of the scapula, and anteriorly to the external surface of the eight or nine first ribs, by digitations, the length of which increases as they descend. The external surface of this muscle is covered before and below by the skin; behind, it is in connexion with the latissimus dorsi and subscapularis, and above and in front with the pectoral muscles, the axillary vessels, and brachial plexus. Its internal surface covers the side of the thorax.

We see, then, that the axilla is formed in front by the pectoral muscles, behind by the latissimus dorsi and teres major, and internally by the serratus magnus. Superiorly, it communicates with the lateral and inferior parts of the neck by an opening comprised between the ribs, clavicle, and subclavius muscle, from before

to behind; the costo-clavicular ligament and coracoid process, from within outwards. It is longer externally than internally, and has the form of a triangle, the base of which corresponds to all the portion of the coracoid process which is not in connexion with the clavicle. According as the shoulder is carried forwards, or backwards and downwards, the space between the clavicle and first rib will be increased or diminished. By carrying the shoulder forcibly outwards and downwards, the axillary vessels and nerves may be compressed between the clavicle and the second rib, so as to impede the circulation in the limb. If, on the contrary, it is intended to exercise the pressure on the first rib, the shoulder should be carried forwards so as to increase the extent of the space in question; it is through this opening the cellular tissue of the neck communicates with that of the axilla, and through it the pus sometimes descends, instead of forming a tumour at the inferior part of the neck. The cellular tissue which fills this cavity, is very abundant, loose, and yielding, notwithstanding the quantity of fat with which it is loaded. This circumstance favours very much the movement of the arm, but it also explains how very readily inflammation extends to all parts of the cellular tissue; and the effusion of pus with which this morbid state is attended. Abscesses of these parts should be opened early, for the destruction of the cellular tissue which fills the axilla would produce separation of its parietes, and give rise to the formation of fistulous ulcers.

The cellular tissue of the axilla contains a great number of blood-vessels and lymphatic ganglia. Several of these glands are situated below the inferior edge of the pectoralis major, others occupy the posterior edge of the axilla near the neck and inferior costa of the scapula. These ganglia not only receive the lymphatics from the upper extremity, but also most of those from the mammæ. The difficulty of their extirpation, when they are diseased, varies according to their situation; if they are situated beneath the inferior edge of the pectoralis major, and near the thorax, they may be extirpated without fear; whilst, if they are near the humerus, the greatest precautions must be taken not to wound the

axillary vessels. In removing the glands situated near the external edge of the scapula, the brachial artery will not be endangered, but the trunk of the common scapular. The extirpation of the glands not situated near the edges of the axilla is never followed by a fatal hæmorrhage, but secondary bleeding from some of the thoracic branches of a very troublesome nature frequently occurs. To avoid this, the operator should observe, before he removes a large gland or a chain of ganglia, if there be no vein of size in the neighbourhood; if there be one, he should seize it between the finger and thumb, for the branches of the arteries and thoracic veins generally accompany each other, and having inclosed both vessels in a ligature, the operation may be completed with safety.

CHAPTER X.

MIDDLE REGION OF THE ARM.

§ 145. The arm, in the widest acceptation of the word, comprehends all the upper extremity, which may be divided into shoulder, arm, fore-arm and hand. Hence, under the term middle region of the arm is understood the space between the limits of the scapulo-axillary region, and the inferior part of this limb, or the region of the hand. The true commencement of this last region is below the inferior extremity of the radius and ulna; but not to separate the description of parts which ought to be studied in connexion with each other, we will consider, at the same time, the hand and its articulation with the fore-arm, and we will imagine, as the limit between the middle and inferior parts of the superior extremity, a line surrounding the fore-arm immediately below the projections which the bones of this part present at their articulation with those of the carpus.

The arm, properly so called, exhibits, at its ante-

rior and inferior part, a prominence formed by the deltoid muscle, and above the elbow joint an angle formed by the junction of the arm with the fore-arm, bounded on each side by the projecting lines formed by the muscles which are attached to the condyles of the humerus. This depression is less apparent during extension than flexion of the arm, and inferiorly it extends to the anterior surface of the fore-arm. The tendon of the biceps may generally be felt through the teguments of the elbow; it is situated towards the middle of this part, a little nearer the external than the internal condyle of the humerus, and the projection of the tendon is more apparent when the fore-arm is in a state of flexion and supination, that when it is extended. In most persons we also observe, in this situation, some veins which are distinct in proportion to the muscularity of the subject, and the absence of fat: these vessels are usually four in number; the basilic vein, situated on the internal muscular projection, the cephalic placed externally, the median cephalic, situated between the latter and the tendon of the biceps; and, finally, the median placed between this tendon and the internal muscular projection. The pulsations of the brachial artery may generally be felt between the tendon of the biceps and the median vein; lastly, the median nerve is easily recognised through the skin, between the artery and the internal muscular eminence. At the arm the cephalic and basilic veins are distinguished by the raised lines which they form on both sides of this part of the upper extremity. The posterior surface of the arm presents superiorly a depression corresponding to the insertion of the deltoid, and is commonly selected for the insertion of issues. At the elbow we recognise three projections of bones, placed on the same line when the fore-arm is extended; during the flexion of this limb, the middle is the most obvious, and is formed by the olecranon of the ulna; it descends beyond the two lateral ones formed by the condyles of the humerus.

§ 146. The skin of the arm varies in thickness in different parts. On the fore-arm it is abundantly supplied with hairs, two very distinct layers of cellular

tissue, the one placed immediately under the skin containing much fat; the other, placed between this last and the brachial aponeurosis, is composed of loose cellular tissue containing no adipose substance. In women and children this fatty layer is very thick; hence, the operation of phlebotomy is frequently more difficult in them than men; for the more the fat accumulates under the skin, the more deeply are the subcutaneous veins situated. On the anterior surface of the fore-arm, the cellular layer is thinner than at the elbow. At the posterior surface of the arm we find only one layer of cellular substance, thinner and looser than on the anterior part; it generally contains very little fat, is slightly yielding, and intimately connects the skin to the subjacent aponeurosis. Between the skin and olecranon there is a kind of bursa mucosa for facilitating the movements of these parts; it may be easily extirpated, if disease of the part renders this operation necessary. The cicatrix which follows a wound with loss of substance, is much less extensive at the anterior than the posterior part of this region. At the posterior part of the arm the skin is very thick, and of a firm texture, so that abscesses formed at this part make their way with difficulty to the surface, and by their diffusion separate the skin to a considerable extent. The great looseness of the subcutaneous cellular tissue of the anterior part of the limb, and its very slight adhesion to the skin, and aponeurosis beneath it, should induce the surgeon to open the abscesses in this spot early.

§ 147. We find, between the deep layers of this cellular membrane, a considerable number of veins, lymphatics, and nerves. At the inferior part of this region, the veins frequently communicate with each other, and present, in different subjects, numerous varieties. The *cephalic*, or *vena radialis cutanea externa*, is the continuation of the cephalic from the thumb, and proceeds along the outside of the fore-arm; arrived at the bend of the elbow, it receives the median cephalic, continues to ascend towards the shoulder, passes, on the outer muscular prominence, along the external part of the biceps, and is placed between the deltoid and

the pectoralis major, to open into the subclavian. (Vide § 128.) Below the elbow, this vessel is connected with some branches of the external cutaneous nerve, and opposite the joint, it passes near the truuk of the same nerve, which soon dips down beneath the aponeurosis of the arm. In the remainder of its course, it is not connected with any important organ; hence, a person unaccustomed to bleed, had better open this vein than the median, which is placed very near the brachial artery.

The *basilic vein*, situated at the internal side of the anterior surface of the arm, is formed by the junction of the anterior and posterior ulnar and median basilic. The posterior ulnar arises from the internal part of the back of the hand, ascends on the posterior part of the fore-arm, then on its inner and anterior surface, on the internal muscular prominence at the bend of the elbow, and passes before the internal condyle, in order to reach the inner edge of the biceps. The anterior, rather smaller than the former, arises from the inferior part of the fore-arm, and ascends towards the bend of the elbow to join the posterior ulnar. They communicate also with each other, and with the radial, by numerous anastomotic branches, and are lodged between the integuments and the aponeurosis as far as the inferior part of the arm, where the trunk which they form passes under this membrane to continue its course towards the armpit.

The *common median vein*, formed by the union of several branches spread on all the anterior surface of the fore-arm, is situated in the centre of this region; arrived at the bend of the elbow, it sends a branch of communication to the deep brachial veins, and then divides into two trunks which open into the cephalic and basilic veins, and which are called, for that reason, *median cephalic* and *median basilic*. The first of these vessels goes obliquely from below upwards, and from without outwards, into the triangular space which the two muscular prominences at the bend of the elbow leave between them. The *median basilic* ascends, on the contrary, obliquely from without inwards, along the tendon of the biceps, and almost parallel to the external

border of the internal projection of muscle. The median cephalic is lodged in the subcutaneous cellular tissue, and rests on the brachial aponeurosis; it some times crosses the course of the brachial artery; hence, in bleeding, it occasionally happens that this vessel is wounded. We shall speak of the precautions which are necessary to be taken to avoid this serious accident, when we have described the parts which separate these two vessels, and also the course of the artery.

The *internal cutaneous nerve*, the smallest of the branches which terminate the brachial plexus, (vide § 133.) descends along the internal surface of the arm, by the side of the basilic vein, and, arrived almost opposite the inner condyle, divides into two branches; the one, external, pierces the aponeurosis, traverses the middle of the bend of the elbow, and terminates in the integuments at the inferior part of the fore-arm; the other, internal, which is considered to be the continuation of the trunk, accompanies the basilic vein. Near the inner condyle, it divides into two branches, one of which goes obliquely downwards and outwards, passes at one time before, at another time behind the median basilic, to terminate in the integuments of the fore-arm and hand; the other turns round the back of the arm, above the inner condyle, and descends along the ulna towards the back of the hand. The *external cutaneous nerve* emerges from beneath the brachial aponeurosis opposite the tendon of the biceps, traverses the bend of the arm, passes sometimes before, but, in general, behind the median cephalic, and along the external side of the median vein. It is to avoid the accidents which happen from the pricking of this nerve that this vein is not usually opened in bleeding.

The *superficial lymphatic vessels of the upper extremity* accompany the subcutaneous veins, and form at the anterior surface of the fore-arm several trunks, which traverse sometimes one or two small ganglia at the bend of the elbow, and which ascend on the inner and outer side of the arm to reach those lodged in the axilla (vide § 144.) In addition to this, these vessels do not present any thing remarkable.

§ 148. Below the integuments, the subcutaneous cel-

lular layer, vessels, and superficial nerves of which we have just spoken, we find the *brachial aponeurosis.* This whitish covering degenerates often into cellular tissue towards the upper part of the limb, and only becomes distinct below the deltoid. It is attached to the clavicle, acromion, and spine of the scapula; it is continuous with the cellular tissue of the armpit, and receives aponeurotic expansions from the tendons of the pectoralis major and serratus magnus. Anteriorly it is less thick than at the posterior and external surface of this part; but it is principally on the inner side that it presents the greatest strength and thickness. This arrangement is owing to the union in this point of the cellular aponeurosis, situated between the biceps and brachialis internus, and of the internal intermuscular ligament. At the elbow, this aponeurosis is continued with the antibrachial aponeurosis before and behind, and on the lateral parts some bundles of fibres are detached from it, which are fixed to the tuberosities of the inferior extremity of the humerus. The aponeurotic sheath of the fore-arm is much thicker and firmer than that of the arm; it presents also whitish fibres much more distinct internally than posteriorly. At the bend of the arm it receives, from the internal side, a layer, which is detached from the tendon of the biceps, and from the external side, an aponeurosis proceeding from the brachialis anticus, and which turns round the tendon of the biceps, before it terminates on the internal muscular prominence. We observe also in this part a longitudinal fissure closed by very firm cellular tissue, and giving passage, by its upper falciform extremity, to the external cutaneous nerve. Laterally, the antibrachial aponeurosis is strengthened by bundles of fibres which are fixed to the external and internal condyles; and, behind, a prolongation is sent from the tendon of the triceps. Between the internal condyle and olecranon, there is a transverse slip, which unites the two attachments of the flexor carpi ulnaris, and under which the ulnar nerve passes. Lastly, after being united to the aponeurotic layers, which form the partitions between the pronators and flexors of the fingers, the antibrachial aponeurosis becomes attached to the

internal border of the ulna, and descends towards the wrist to be continuous with the ligaments of the carpus.

Abscesses beneath the aponeurosis of the upper extremity should be opened as soon as we are aware of their existence; any delay might be attended with very serious consequences. The resistance which this aponeurotic sheath offers to the swollen part, situated beneath it, sometimes occasions very severe symptoms in wounds from the bursting of fire-arms, or other causes. In fact, the expansion of the inflamed parts being prevented, the vessels and nerves become compressed to such a degree as to produce gangrene of the limb. Free incisions only give relief in these cases, for almost as soon as they are made the pain subsides, the circulation is restored, and the inflammation follows its ordinary course. The aponeurosis which envelopes the upper extremity is much thicker and firmer in the fore-arm than the arm.

§ 149. Immediately under the aponeurosis, which covers the anterior surface of the arm, we find *the biceps*, thus called on account of its two fleshy bellies, one, called *the long portion of the biceps*, is attached by a long and thin tendon to the superior portion of the glenoid cavity of the scapula. The other portion, shorter, and situated to the inner side of the former, is attached to the coracoid process, conjointly with the coraco-brachialis. These two fleshy bellies, separated at first by cellular tissue, unite in the middle of the arm, and descend almost vertically towards the bend of the elbow. The inferior tendon of the biceps commences a little above the humero-cubital articulation, and descends obliquely outwards.

The tendon of the biceps then dips between the supinator radii longus, and pronator radii teres, proceeds round the radius, and is fixed to the inferior and posterior part of the tuberosity of this bone. In this region, this muscle is in connexion, by its anterior surface, with the brachial aponeurosis and the integuments, and by its posterior surface, with the humerus, the coraco-brachialis, the musculo-cutaneous nerve, and the brachialis anticus, from which it is separated by a

layer of cellular tissue, which is continuous inferiorly with the antibrachial aponeurosis, and often presents the appearance of a fascia, especially towards the bend of the elbow. The biceps is thus inclosed in a kind of sheath, and only adheres to it by some few filaments of very loose cellular tissue. Hence, when this muscle is divided, nothing opposes the retraction of the two portions to a considerable extent. The external border of the biceps is free; its internal edge is united superiorly to the coraco-brachialis; against its centre and inferior part the brachial artery rests.

§ 150. At the superior and posterior part of this region, immediately beneath the brachial aponeurosis, we find the *triceps*, the central portion of which, as we have already seen, is attached to the axillary costa of the scapula. External to this belly, we find another portion of the triceps smaller than the former, and which is inserted into the superior part of the outer edge of the humerus and external intermuscular aponeurotic septum. Lastly, a third portion, still shorter than the former, is placed at the inner side of the middle belly, and arises from the internal part of the humerus, immediately below the attachment of the latissimus dorsi and teres major. After being united, these three portions of the triceps form a large and thick belly, which is joined by some fleshy fibres that come from the back part of the lower third of the humerus. Inferiorly, it terminates in a strong tendon, which is fixed to the superior and posterior part of the olecranon, and sends a fibrous prolongation to the antibrachial aponeurosis. The fibres which arise from the external border of the humerus, leave a small opening between them for the passage of the radial nerve, and the external collateral vessels. We have already pointed out the relations of the superior extremity of this muscle; the portion, situated in the region which now occupies our attention, corresponds, by its posterior, to the brachial aponeurosis, and by its anterior surface to the humerus, nerves, and vessels of the arm, and lastly, the elbow-joint.

§ 151. The muscular prominences, which we have said were placed on each side of the bend of the arm,

are separated superiorly by the whole length of the brachialis anticus; but in descending they approximate and terminate together. They are formed by the superficial muscles of the fore-arm, which are very distinct at the inferior part of this region, but which, near the elbow, form only two fleshy bellies. The supinator radii longus, extensores carpi radiales longior et brevior, extensor communis digitorum, extensor proprius minimi digiti, anconeus, and extensor carpi ulnaris, form the external muscular projection. The internal is formed by the pronator teres, flexor carpi radialis, and palmaris longus, flexor sublimis digitorum, and flexor carpi ulnaris. The first arise principally from the inferior part of the external border of the humerus and outer condyle, by a common tendon. In fact, the *supinator radii longus* is fixed, to the extent of about two inches, to the external border of the humerus, between the brachialis internus, triceps, and the aponeurosis, situated between it and this last muscle; thence, it descends vertically, and terminates on the inferior extremity of the radius. The anterior surface of this muscle is covered by the antibrachial aponeurosis, the posterior is connected with the supinator brevis, extensor carpi radialis longior, pronator teres, flexor carpi radialis, flexor sublimis digitorum, flexor longus pollicis, and the radial nerve and artery; its internal border rests on the brachialis internus and radial nerve. The *extensor carpi radialis longior* is attached to the outer edge of the humerus, external intermuscular aponeurosis, and the outer condyle superiorly, and inferiorly to the second bone of the metacarpus. Placed by the side of the former, it is covered by it and the antibrachial aponeurosis, then by the abductor longus pollicis; its posterior surface is in contact with the elbow, supinator brevis, and *extensor carpi radialis brevior.* This last muscle arises from the common tendon which is fixed to the outer condyle, and from an aponeurotic sheath, which separates it from the extensor communis; inferiorly, it is inserted into the third bone of the metacarpus. Its superior extremity is covered by the supinator radii longus, and extensor carpi radialis longior, and rests on the supinator brevis, pro-

nator teres, and the radius. The *extensor communis digitorum* is attached to the outer condyle by the common tendon of which we have already spoken, to the antibrachial aponeurosis, and to the septum which this fibrous membrane sends between it and the extensor carpi radialis brevior and extensor proprius minimi digiti towards the middle of the posterior surface of the fore-arm; this muscle then divides into four distinct portions which terminate by tendons, the description of which will be given in the following chapter. The posterior surface of this muscle is covered by the aponeurosis; the anterior covers the deep layer of muscles on the back part of the fore-arm. The *extensor minimi digiti* is placed to the outer side of the former, and is also attached to the outer condyle and aponeurotic septum, which separates it from the common extensor and flexor carpi ulnaris. At its upper part it is firmly connected to the antibrachial aponeurosis by its posterior surface, to the extensor communis by its external, and to the extensor carpi ulnaris by its internal border. The *anconeus* is a small, thin, and triangular muscle, placed behind the elbow-joint, and often not distinguishable from a part of the triceps. It is fixed to the outer condyle by a distinct tendon, and thence proceeds to the olecranon and upper fourth of the outer edge of the ulna. At its inferior border it is oblique, and contiguous with the *extensor carpi ulnaris;* which arises from the outer condyle by the common tendon, from the septum which separates it from the extensor minimi digiti, from the antibrachial aponeurosis, and from the middle third of the posterior edge of the ulna; inferiorly, this muscle terminates in a tendon, which is attached to the fifth bone of the metacarpus.

The mass of muscles situated on the inside of the arm arises from the inner condyle, by a common tendon, and intermuscular aponeurotic septum. It is formed by, 1st. The *pronator teres*, which extends obliquely to the superior and anterior part of the fore-arm, is fixed superiorly to the internal condyle, coronoid process, antibrachial aponeurosis, and fibrous septum, which separates it from the flexor carpi radialis and flexor sublimis; inferiorly, to the outer surface of the

radius. The external surface of this muscle is covered in its two superior thirds by the antibrachial aponeurosis, and in its inferior third by the supinator radii longus, radial nerve, and vessels, and the extensor radial muscles. Between the outer and inner edge of the supinator radii longus, we find a triangular space, the apex of which is turned downwards; it lodges the tendon of the biceps, the brachial artery, and median nerve. The posterior surface of the pronator teres covers the brachialis anticus, flexor sublimis, ulnar artery, and median nerve. 2. The *flexor carpi radialis* is situated to the inner side of the former, and has also the same attachment superiorly; it terminates by a tendon, which is inserted into the second bone of the metacarpus; its anterior surface is covered externally by the supinator radii longus, and the remainder of its extent by the common aponeurotic sheath. Its posterior surface rests on the flexor sublimis, and flexor longus pollicis manûs. 3. The *palmaris longus* is situated to the inner side of the flexor carpi radialis: it arises from the internal condyle and the intermuscular septum, and terminates on the palmar aponeurosis; this muscle is frequently wanting. 4. The *flexor sublimis digitorum*, which, placed under the pronator teres, flexor carpi, radialis internus, palmaris longus and antibrachial aponeurosis, is attached superiorly to the inner condyle by means of the common tendon, to the coronoid process of the ulna, and to the aponeurotic septum which separates it from the neighbouring muscles; it receives also some fibres from the anterior border of the radius: inferiorly, it divides into four distinct portions, the tendons of which are inserted into the fingers. The posterior surface of this muscle covers the flexor proprius pollicis, ulnar artery, and median nerve. The *flexor carpi ulnaris* terminates posteriorly this muscular layer; its superior extremity is fixed to the internal condyle by means of the common tendon, and to the inner side of the olecranon, the antibrachial aponeurosis, and the fibrous septum, which separates it from the flexor sublimis. The tendon, by which this vessel terminates. is inserted into the pisiform bone.

The brachial vessels and median nerve, situated to

the internal side of the biceps, are covered by the *internal intermuscular ligament.* This aponeurotic septum is attached to the internal border of the humerus, between the biceps and the brachialis anticus, and to the inner condyle; in front of the biceps it is continuous with the brachial aponeurosis; its size increases as it descends. At the internal condyle it divides, in order to form septa for the muscles, which are inserted into this prominence. The space which exists between this fibrous septum, the anterior surface of the brachialis anticus, and the internal border of the biceps, increases in size from the armpit towards the bend of the elbow; and opposite the internal condyle of the humerus, it extends transversely from this bony prominence to the tendon of the biceps. Inferiorly, the internal intermuscular ligament is united also to the antibrachial aponeurosis and the fibrous layer which proceeds from the internal border of the biceps, on the external muscular layer, and which also covers the brachial artery.

The cellular tissue in this region (vide § 149.) is continuous internally with the aponeurotic layer, situated between the biceps and the brachialis anticus, and forms a sheath around the median nerve and brachial vessels.

The *median nerve* is first seen when the cellular sheath, which is common to it, and the artery and brachial veins, is opened. This nerve arises from the anterior part of the brachial plexus (vide § 133.), and descends a little outwards, behind the internal part of the biceps, and within the artery; arrived at the bend of the arm, it proceeds generally on the inner side of this vessel, and is continued along the tendon of the biceps the whole of its length; and lastly, sinks down between the brachialis anticus and pronator radii teres. The *brachial* or *collateral veins* are generally two in number, and open into the axillary at the same place as the basilic (§ 132). They ascend on each side of the artery, and in different parts of their course give off small branches which completely surround this vessel. Sometimes there is only one deep vein from the bend of the elbow to the armpit: when this is the case, the vein is situated at the internal side of *the brachial artery.*

This last vessel is the continuation of the axillary, and extends from the armpit to about an inch below the humero-cubital articulation, where it divides into the ulnar and radial arteries: it proceeds along the internal border of the biceps, follows the direction of a straight line, drawn from a spot between the attachments of the pectoralis major and latissimus dorsi, to the middle of the bend of the elbow: the nearer it approaches this part, the more superficial and external it becomes. Internally the artery is connected with the brachial vein and median nerve, to which it is united by cellular tissue, and their common sheath. Anteriorly, it is covered by the brachial aponeurosis and coraco-brachialis, from which it is separated by a great quantity of cellular tissue: behind, it is separated superiorly from the triceps by a large quantity of fatty cellular tissue; in its inferior third, it is supported by the brachialis anticus; lastly, it rests on the inner surface of the humerus, the insertion of the coraco-brachialis, and the groove formed by the triceps and brachialis anticus.

From the anatomical details which we have related, we perceive that it would be very easy to compress the brachial artery on the humerus, so as to produce its obliteration; but the putting a ligature on this vessel is so easy an operation, and so generally successful, that, in most cases, it is preferred. To perform this operation, it is only necessary to divide the integuments along the inner edge of the biceps, and the aponeurosis covering the vessel, and then to separate the artery from the cellular tissue, which unites it to the median nerve and brachial veins, and which forms their common sheath. To facilitate this part of the operation, Hodgson advises the artery to be compressed above the wound. Lastly, the ligature ought to be passed from without to within, and care must be taken not to compress the nerve or the veins. Sometimes, the brachial artery, instead of dividing only at the bend of the elbow, gives rise to the radial, ulnar, and even interosseal arteries, much higher up in the arm. The radial artery most frequently presents this irregular origin: when this occurs, the vessel in general accompa-

nies the ulnar artery, below the aponeurosis, to the bend of the arm, and passes then from the other side of the limb. But this is not the case when the ulnar artery rises higher than usual; for it is then always placed more superficially than the radial, and often escapes from beneath the brachial aponeurosis, to become subcutaneous towards the inferior part of the arm. The irregular origin of the interosseous artery is much rarer, and is of less import to the surgeon than a knowledge of the varieties of the two arteries which we have described. In fact, the origin of the radial and ulnar arteries above the bend of the arm multiplies the chance of injury in these vessels, and, after the obliteration of both, renders the re-establishment of the circulation much easier. If the surgeon were unacquainted with this beforehand, he might be greatly embarrassed in the operation of tying the brachial artery. If, in performing this operation at the middle part of the arm, in a case of aneurism, two arteries, proceeding one by the side of the other, were met with, it would not be necessary to include both in the ligature, as some surgeons have recommended, but first to compress one, and then the other, to ascertain which communicates with the tumour, and which ought to be tied.

At the bend of the elbow, the brachial artery descends obliquely outwards and backwards, and passes under the inferior aponeurosis of the biceps, which separates it from the median basilic vein. By its posterior surface, this vessel is in contact with the brachialis anticus, and then with the tendon of the biceps, to which it is sometimes united by cellular tissue. If the fore-arm be forcibly proned, the brachial artery, as well as the tendon of the biceps, are carried under the external muscular prominence, whilst the veins situated above the common aponeurosis become, on the contrary, more superficial. It is on this account that some surgeons advised the arm to be placed in this position, when the median basilic vein is opened. In fact, this vessel is only separated from the humeral artery by a layer of fatty cellular tissue, by the brachial aponeurosis, and aponeurotic expansion of the biceps; and, in lean persons, the thickness of these intermedi-

ate parts is so very small, that the two vessels are almost in contact. It is evident, then, how easily the artery may be wounded, especially if the lancet be introduced perpendicular to the axis of the limb, instead of being directed obliquely. By means of pressure, we can, in general, suspend the hæmorrhage which then ensues, but the consequences are still very serious; for a wound of this artery is always followed by the formation of an aneurism, unless sometimes the vessel has been completely obliterated in the injured part. When the lancet traverses the vein, and penetrates to the artery, so that the opening of the artery, and that of the corresponding wall of the vein are parallel, the communication between these two vessels may remain after the cicatrization of the anterior parietes of the vein and integuments has taken place: the arterial blood then passes into the vein, and thus causes the formation of an aneurismal varix. But this does not ordinarily occur after the accident of which we have been speaking. In most cases, the blood escapes from the artery into the cellular tissue, and forms a traumatic aneurism, diffused or circumscribed, according as the opening made in the artery is large or small, and as the cellular tissue which surrounds this vessel is loose, or has contracted adhesions with the neighbouring parts. The anatomical details which we have above related, relative to the internal intermuscular ligament and aponeurosis of the biceps, explain the reason why circumscribed aneurisms, at the bend of the arm, which succeed bleeding, often present an oval form; in fact, this is the form of the space comprised between this ligament, the tendon of the biceps, and the internal condyle of the humerus. The triangular form of the diffused aneurism depends also on the space comprised between the internal intermuscular ligament and the biceps, which diminishes in size from the bend of the arm towards the armpit.

§ 153. The two branches by which the brachial artery terminates, separate from each other at an acute angle, and dip between the anterior muscles of the forearm. *The radial artery*, smaller and more superficial than the ulnar, descends under the supinator radii lon-

gus, towards the inferior part of the fore-arm, following the direction of an oblique line, which extends from the middle of the bend of the arm to the superior and internal part of the thumb. It is separated from the anterior surface of the radius by fatty cellular tissue and the supinator brevis, flexor longus pollicis, and pronator quadratus: at the inferior part of this region it rests immediately on the radius. At its internal side the radial artery corresponds with the pronator radii teres, flexor carpi radialis, and flexor sublimis. Externally it is in contact with the supinator radii longus: this last muscle covers also the two thirds of its anterior surface, from which it is separated by radial veins and a great quantity of cellular tissue. Lastly, at the inferior part of the fore-arm, this vessel is only covered by the common aponeurosis and integuments. We then find that the radial artery becomes more superficial the nearer it approaches the hand, and also that it is more easily tied at the inferior than superior part of the fore-arm. To perform this operation near the bend of the elbow, the integuments must be divided a little below the insertion of the tendon of the biceps, to the extent of about two inches and a half, and obliquely following the direction of the border of the supinator radii longus. The subjacent aponeurosis must then be divided, and the edge of the supinator radii longus must be carried a little outwards, to enlarge the space which exists between this muscle and the flexor carpi radialis: the radial artery then presents itself to our sight at the place where it passes over the tendon of the pronator radii teres, and on the long flexor of the thumb. At the external side of this vessel, we find a branch of the external cutaneous nerve, which leaves it towards the middle of the fore-arm, to pass under the long supinator. Near the wrist, the incision of the integuments and the antibrachial aponeurosis must be made a little beyond the outer side of the tendon of the flexor carpi radialis.

§ 154. The *ulnar artery* is larger than the radial, and descends along the anterior and internal part of the fore-arm to the palm of the hand. Immediately after its origin, it proceeds a little obliquely inwards, tra-

verses the pronator radii teres, and then descends between the flexor sublimis digitorum and deep muscular layer. Towards the middle part of the fore-arm, the ulnar artery becomes vertical and subcutaneous. Anteriorly, it is connected at first with the median nerve and pronator radii teres, then with the flexor carpi radialis and palmaris longus, the flexor sublimis and flexor carpi ulnaris; inferiorly, it is separated from the skin only by the antibrachial aponeurosis and subcutaneous cellular tissue. On its inner side it has the ulnar nerve and vein and flexor carpi ulnaris, and on its outer side the flexor sublimis; lastly, it rests posteriorly on the brachialis anticus, flexor profundus, and pronator quadratus. At the superior part of the fore-arm, the ulnar artery describes a slight curvature, the convexity of which is turned inwards and backwards; but then its direction corresponds exactly to that of a line drawn from the middle of the bend of the arm to the superior and internal parts of the palm of the hand. To tie this vessel at the superior part of the fore-arm, an incision must be made through the integuments and antibrachial aponeurosis along the internal border of the flexor carpi radialis, between this muscle and the flexor sublimis. At the inferior part of this region, it is sufficient only to divide the integuments and aponeurosis, to get at the artery, which is situated between the tendons of the two muscles of which we have just spoken.

§ 155. Immediately after its origin, the ulnar artery gives off the *anterior recurrent ulnar*, a small branch, which descends at first between the flexor carpi radialis, pronator radii teres, and brachialis anticus, and then ascends on the anterior part of the internal condyle, where it anastomoses with the *internal collateral artery*. This last vessel separates from the brachial artery, proceeds inwards in front of the brachialis anticus and median nerve, traverses the internal intermuscular aponeurosis, and divides into two branches, one of which terminates on the inner condyle, the other near the cavity for the olecranon of the humerus. The *posterior recurrent ulnar artery* also arises from the ulnar, but a little below the anterior; it proceeds at first downwards and inwards, on the flexor profundus and under the pro-

nator radii teres, flexor carpi radialis, and flexor sublimis, then ascends between the outer condyle to the olecranon, along the ulnar nerve, and anastomoses with the internal collateral and *deep humeral* or *external collateral.* This vessel arises generally from the branch above the superior extremity of the internal portion of the biceps; sometimes, however, it proceeds from the posterior circumflex, or even the common scapular. It proceeds backwards and downwards, passes between the biceps and posterior surface of the humerus, then between this muscle and the brachialis anticus, departs by the space which separates them, becomes superficial, and then descends vertically towards the elbow, along the posterior and external part of the arm. Arrived near the outer condyle, the deep humeral artery divides into two branches, which are distributed to the muscles and integuments of the elbow, and anastomose with the recurrent radial artery, recurrent interosseal, and internal collateral. The *recurrent radial artery* separates from the radial at its origin; it takes a course at first transversely outwards, then dips down between the supinator radii longus, supinator brevis, and brachialis anticus; and reaches the olecranon by forming an arch, from the convexity of which several branches proceed to be distributed to the neighbouring muscles. The *recurrent interosseal artery*, or posterior radial, is one of the divisions of the interosseal branch of the ulnar, and ascends between the anconeus and the extensor carpi ulnaris to the outer condyle, where it anastomoses with the two former. It is principally by the assistance of these numerous vascular communications that the circulation continues in the inferior part of the upper extremity, after the obliteration of the brachial artery.

§ 156. The median nerve, which we have already followed from the axilla to the bend of the arm, dips down between the pronator radii teres and brachialis anticus, and descends in the same manner as the ulnar artery, between the deep and superficial flexors of the fingers, but it is always at a sufficient distance not to be included in the ligatures applied to this vessel. The *ulnar nerve* arises from the posterior and internal part of the brachial plexus, descends almost vertically along the

internal border of the biceps, passes between the inner condyle and olecranon, then between the two points of the superior attachments of the flexor carpi ulnaris. In this part of the arm it is situated by the side of the posterior recurrent ulnar artery. Then this nerve proceeds obliquely downwards and forwards, following the course of the ulnar artery. It is distributed to a great number of muscles destined to move the fingers and hand; hence, in removing the inferior extremity of the humerus, great care must be taken not to divide this nerve, for this would be followed by paralysis of the fingers: on that account, it is advisable to isolate this nerve from a kind of sulcus, in which it is lodged, between the inner condyle and olecranon, and to carry it in front of the first of these bony prominences, before sawing through the portion of the humerus which is about to be removed. The trunk of the *internal cutaneous nerve*, concealed at first in the cellular tissue of the hollow of the axilla, becomes more superficial in its descent between the median and ulnar nerves; it accompanies very constantly the basilic vein, but sometimes it is found before, sometimes behind, and at other times on the sides of this vessel. A little above the inner condyle, the internal cutaneous nerve divides into two branches (vid. § 210). The *external cutaneous nerve*, the branches of which we have seen distributed between the integuments and antibrachial aponeurosis in the inferior half of this region, is situated more deeply towards its superior part; for it descends obliquely before the coraco-brachialis, traverses this muscle, and is then situated between the biceps and brachialis anticus; on a level with the tendon of the former of these muscles, it proceeds outwards, traverses the middle of the bend of the elbow under the cephalic median vein, and then becomes subcutaneous. Lastly, the *radial nerve*, situated above the deep humeral artery, follows the course of this vessel to the humero-ulnar articulation, where it divides into two branches; the one, anterior, descends along the anterior and external part of the fore-arm, on the outer side of the radial artery; the other, posterior, and larger than the former, proceeds

obliquely outwards, and dips down between the muscles of the posterior surface of the fore-arm.

§ 157. Between the parts which we have described and the bony frame-work of the upper extremity, we find a second muscular layer; formed anteriorly by the brachialis anticus, supinator brevis, flexor profundus, flexor longus-pollicis, and pronator quadratus; posteriorly, by the abductor longus-pollicis, extensores primi et secundi internodii pollicis, and by the indicator. The *brachialis anticus* is situated in front of the elbow-joint; it is attached to the internal and external surfaces of the humerus, and extends from the point of insertion of the deltoid to the coronoid process of the ulna, where it is inserted by a strong rough tendon. The anterior surface of this muscle is covered by the common aponeurosis, supinator radii longus, biceps, external cutaneous nerve, brachial artery, median nerve, and pronator teres. Posteriorly, it is connected with the inferior extremity of the humerus and the elbow-joint. The *supinator brevis* occupies the superior part of the fore-arm, and surrounds the head of the radius; it is large, thin, triangular, and is inserted on one side into the outer condyle, the external lateral ligament of the elbow-joint, the annular ligament of the radius, and to the posterior surface of the ulna; and on the other, into the anterior, external, and posterior surfaces of the radius. This muscle is connected anteriorly with the supinator radii longus, pronator teres, with the radial vessels and nerves; posteriorly, with the extensor communis digitorum, extensor proprius minimi digiti, extensor carpi ulnaris and anconeus. The *flexor profundus digitorum* is a thick, flattened, fleshy bundle, elongated, and curved so as to surround the ulna; inferiorly, it divides into four distinct tendons. Its superior extremity is, on the contrary, not divided, and is fixed to the superior three-fourths of the ulna and interosseous ligament, to the olecranon, and upper third of the internal surface of the ulna. It is covered by the flexor sublimis and flexor carpi ulnaris, by the median and ulnar nerves, and by the ulnar artery. The *flexor longus pollicis* covers, in a small degree, this last muscle externally; it is inserted into the superior three-fourths

of the anterior surface of the radius, and into the neighbouring part of the interosseous ligament; its anterior surface is covered by the flexor sublimis, flexor carpi radialis and supinator radii longus, and by the radial vessels. Between this muscle and the flexor profundus we find the anterior branch of the *interosseal* artery. This vessel arises from the ulnar a little below the bicipital tuberosity of the radius, proceeds horizontally backwards, and divides into two branches, one of which descends vertically in front of the interosseous ligament, down to the wrist, which it traverses in order to proceed on the back of the hand. The posterior branch passes above the interosseous ligament, proceeds under the anconeus, at which place the recurrent interosseal arises from it, and then descends towards the hand, between the superficial and deep layers of muscles at the posterior surface of the fore-arm. The *pronator quadratus*, a thin muscle, and of a quadrilateral form, occupies the lower portion of the anterior surface of the fore-arm; it is attached to the lower fourth of the anterior borders of the ulna and radius, extending transversely from one bone to the other; lastly, it is covered anteriorly by the deep flexor of the fingers, the flexor longus pollicis, flexores carpi radialis and ulnaris, or by their tendons, and by the radial and ulnar arteries; posteriorly, it covers the two bones of the fore-arm, the interosseous ligament and artery.

§ 158. All the muscles which enter into the formation of the deep layer at the posterior surface of the fore-arm, are united into a mass at their superior extremities, which are inserted into the posterior surface of the ulna, and interosseous ligament. The *abductor longus pollicis* is situated also at the upper part of the posterior surface of the radius; thence it descends obliquely outwards, and terminates in a tendon, which is inserted into the first bone of the metacarpus. Posteriorly, this muscle is connected with the supinator brevis, extensor carpi ulnaris, extensor proprius minimi digiti, extensor communis digitorum, extensor longus pollicis, and the antibrachial aponeurosis; anteriorly, it covers a small part of the ulna, the interosseous ligament, the radius, the tendons of the

two extensores carpi radiales, and the radial artery. The *extensor primi internodii pollicis* situated below the former, sends its tendon to the first phalanx of the thumb; its connexions are nearly the same as those of the abductor longus. The *extensor secundi internodii pollicis* arises from immediately below the former muscle, and terminates in a long and thin tendon which goes to the last phalanx of the thumb. Lastly, the *indicator* terminates inferiorly this deep muscular layer, and proceeds, as its name indicates, to the forefinger. Posteriorly, these two last muscles are connected with the extensor carpi ulnaris, the extensor proprius minimi digiti, the extensor communis, and antibrachial aponeurosis.

From what has been said on the superficial muscles of the fore-arm (vide § 150,), we find that, towards the superior part of the upper extremity, these organs form around the bones a very thick fleshy layer, whilst, towards the inferior part of the fore-arm, they present nothing but tendons, surrounded by cellular sheaths, and united to each other by lamellated tissue, void of fat, and forming synovial bursæ. The mobility and resistance of these tendons render the complete and regular division of the soft parts very difficult, when the arm is amputated in the common way by the circular incision. On this account, M. J. Cloquet has recommended the amputation of the fore-arm, at this part, to be performed by introducing a catline first through the integuments on the front, and then on the back of the arm, which is to be carried downwards and outwards till sufficient skin and muscle be preserved for the flaps. Some surgeons recommend the arm to be amputated as low down as possible when there is a choice of spot; most, however, now advise the amputation of the fore-arm to be made at its upper third, just below the insertion of the tendon of the pronator radii teres, in order to avoid the tendons which are situated at the lower part of the limb, and which sometimes prevent union by the first intention. But whatever mode be adopted, the radial, ulnar, and interosseal arteries must be tied with care, and sometimes a rather large branch which accompanies the median nerve; in order

to avoid including the nerves in the ligatures, the arteries should be isolated from the surrounding parts.

§ 159. That part of the upper extremity, which we are now considering, is formed by the inferior two-thirds of the humerus, and superior seven-eighths of the ulna and radius. On the external part of the body of the *humerus*, we find, immediately above the insertion of the deltoid, a kind of superficial groove (vide § 143.), directed obliquely from above downwards, and from behind forwards, and lodging the external collateral artery, and radial nerve (vide § 155.) The internal surface of this bone presents, towards its middle part, inequalities which serve for the insertion of the coraco-brachialis, and a little above an opening directed from above downwards, and serving for the passage of the nutritious artery of this bone. This vessel is naturally very small, but its size is so much increased by certain morbid states of the humerus, that if the arm be amputated near the insertion of the deltoid, in cases of this kind, a considerable hæmorrhage might take place from this vessel. In the remainder of its extent, the internal surface of the humerus is rounded, and gives attachment to the brachialis anticus. Posteriorly, it is covered by the triceps, which is attached to several parts of it. A projecting border separates the inferior portion of the posterior from the external surface, and serves for the attachment of the brachialis anticus, supinator radii longus, extensor carpi radialis, triceps, and external intermuscular aponeurosis. Internally, we also find a projecting line which separates the posterior and internal surfaces of the humerus from each other, and which gives attachment to the triceps, brachialis anticus, and internal intermuscular aponeurosis: the anterior edge of this bone is rounded, and presents nothing remarkable. From the nature of the insertions of the muscles, which surround the humerus, it is evident that, when this bone is fractured in the course of the attachment of the brachialis anticus, the ends of the bone will be displaced, only to a slight degree, because they are both equally exposed to the influence of the brachialis anticus and triceps muscles, which are antagonists, and reciprocally neutralize each

other. Towards the insertion of the deltoid, the fracture of the humerus is accompanied by a very marked deformity; for then the upper fragment is carried outwards and forwards, by the action of the muscles of the shoulder, whilst the under fragment is bent on the ulna by the contraction of the brachialis anticus. But the displacement is particularly marked when the solution of continuity is situated above the point where the deltoid is attached (vide § 143.)

The inferior extremity of the humerus is flattened and curved from before to behind: externally, we find an eminence, which is called the outer condyle, and which gives attachment to the common tendon of the mass of muscles on the outer part of the fore-arm, and to the external ligament of the elbow-joint. On the internal side of the inferior extremity of this bone we find another tuberosity more projecting than the former, and directed a little backwards; this is the inner condyle, which gives attachment to the common tendon of the mass of muscles on the inner side of the fore-arm, and to the internal lateral ligament. Between these two projections we observe a space by which the humerus is articulated with the bones of the fore-arm; we also find here three projections and two intermediate grooves, arranged in a transverse line. The first of these eminences, in proceeding from without inwards, is the small head of the humerus, or condyle, which is rounded and received into the superior cavity of the radius. The kind of pulley, by the assistance of which the humerus is articulated with the ulna, is separated from the condyle by a very deep groove, and by a semicircular crest, which is situated between the ulna and radius. Lastly, the external border of the articular pulley or condyle is situated above the level of the small head of this bone. Above this articular surface, we find, at the anterior part of the humerus, a small superficial cavity, destined to lodge the coronoid process of the ulna when the fore-arm is bent on the arm. At the posterior surface of this portion of the humerus, we find a deeper fossa situated above the condyle, the use of which is also to receive the olecranon, when the limb is extended.

§ 160. The two bones of the fore-arm, placed by the side of each other, touch at their extremities, but leave between them in their centre a very large space. The *radius* is situated external to the ulna, and on a plane anterior to it. It is slightly curved inwards towards its centre, and increases in size towards its inferior extremity; the body of this bone is prismatical and triangular; anteriorly, it is plane, and gives attachment to the flexor longus proprius pollicis, and pronator quadratus: its external surface is rounded, and serves for the insertion of the supinator brevis, and pronator radii teres; inferiorly, it is covered by the tendons of the extensores carpi radiales; posteriorly, is convex, and covered in its upper third by the supinator brevis; in its middle part it is slightly concave, and gives attachment to the abductor longus and extensor secundi internodii pollicis. Lastly, inferiorly, it becomes convex, and is connected with the extensors. The border, which separates the anterior from the posterior surface, is very projecting, and gives insertion to the interosseous ligament; the anterior border gives attachment to the superficial flexors, flexor longus pollicis, supinator brevis, and inferior tendon of the supinator longus. The superior extremity of this bone presents a circular cavity of no great depth, and covered with cartilages to be articulated with the condyle of the humerus. The circumference of this cavity is smooth, and is articulated by its inner side. where it is largest, with the sigmoid cavity of the ulna. The portion of the radius which supports this articular surface is called the neck of the bone; it is about an inch long, rounded, directed rather obliquely outwards, and terminates downwards and inwards, at the bicipital tuberosity, an eminence which gives attachment, internally, to the tendon of the biceps muscle.

§ 161. The *ulna*, placed internal to the radius, is not so long as that bone, and presents a difference in shape, being larger above than below. In amputating an extremity where there are two bones, the operator should commence by sawing the largest, and then direct the saw so as to divide both at the same time; hence, according as the operation is performed, at the upper or

lower part of the fore-arm, the operator must begin by sawing at one time the radius, at another the ulna. The body of this last bone is curved forwards superiorly, and outwards and backwards inferiorly; anteriorly, it is large above, and straight below, gives attachment to the flexor profundus, and pronator quadratus; posteriorly, it is divided into two portions by a projecting longitudinal line. The anconeus and extensor carpi ulnaris are attached to its internal part, which is the largest; externally, it gives attachment to the supinator brevis, abductor longus, and extensor pollicis, and indicator. Internally, it is subcutaneous towards its inferior part, and is covered by the flexor profundus. The external border, which separates the anterior and posterior surfaces, gives attachment to the interosseous ligament; the posterior, to the common aponeurosis, the flexor and extensor carpi ulnaris, and flexor profundus; the internal, to this last muscle and pronator quadratus. The superior extremity of the ulna is very large, and appears principally formed by two processes; the *olecranon* and coronoid process. The first of these eminences is situated posteriorly, and is more elevated than the rest of the bone; the tendon of the triceps is inserted at its apex; posteriorly, it is triangular and subcutaneous; anteriorly, it is concave, and forms part of the articular surface. When the olecranon is fractured, the superior fragment only is exposed to the action of the triceps, consequently, must be carried upwards, whilst the remainder of the bone does not experience any displacement; and, this muscle being an extensor, it is evident that, to lessen this displacement of the fragments as much as possible, we must extend the fore-arm, at the same time pushing the superior fragment downwards. The *coronoid process*, situated before and below the olecranon, is inclined backwards superiorly, and forwards inferiorly, where it presents muscular impressions for the attachment of the brachialis anticus. The superior surface of this eminence joins almost at right angles with the anterior surface of the olecranon, which is more extended than it, and thus forms the great sigmoid cavity: this cavity, covered with cartilages for

articulation with the humerus, is divided into two lateral portions by a projecting line, and externally it is continuous with a small oval fossa before and behind, which is articulated with the head of the radius, and which is called the small sigmoid cavity.

The *internal lateral ligament*, which passes from the outer condyle to the olecranon and coronoid process of the ulna, and external lateral ligament, which is fixed to the external tuberosity of the humerus, and terminates in the annular ligament of the radius, increase the strength of the elbow-joint, and render the lateral dislocation of the fore-arm very difficult. In the antero-posterior direction, the inferior extremity of the humerus presents a kind of cylinder, received into a cavity of the same form, belonging to the ulna. The dislocation of the fore-arm forwards is impossible, on account of the extension and anterior curvature of the olecranon, which embraces the posterior part of the articular pulley of the humerus. Lastly, in order that the dislocation backwards should take place, the top of the coronoid process must be carried beyond the vertical diameter of this articular pulley; for the obliquity of these surfaces is such, that, without it, this last eminence would fall again to the bottom of the great sigmoid cavity, as soon as the power which produces the displacement, ceased to act: it is also on account of the convexity of this articular pulley that the coronoid process glides into the cavity destined for the olecranon, when it has gone beyond the point of which we have spoken. The anterior and posterior ligaments of the articulation do not so much oppose the dislocation of the fore-arm backwards, as the circumstances we have related, and the situation of the muscles which surround the articulation. Hence, in accidents of this kind, we sometimes see the inferior extremity of the biceps and brachialis anticus torn by the humerus. This dislocation is sometimes accompanied by that of the superior extremity of the radius on the ulna, which depends also on one of the peculiarities which we have mentioned: in fact, in order that the coronoid process should pass behind the condyle, the lateral ligament must necessarily be ruptured; but it sometimes hap-

pens that instead of the external lateral ligament being ruptured, the annular ligament on which it terminates gives way, and then the head of the radius being no longer kept in the small sigmoid cavity of the ulna, is dislocated on that bone. Lastly, the situation of the brachial artery, and median, ulnar, and radial nerves, acconnts for their being sometimes torn, in cases of this kind.

§ 162. The articnlation of the radius with the ulna, only takes place at the extremities of these bones; for in the centre they are separated from each other, and only connected by a fibrous membrane. Thus, as we have before said, the circumference of the head of the radius is surrounded by cartilages, and received into the small sigmoid cavity of the ulna. A very strong fibrous band, abont two lines in length, snrrounds the superior extremity of this bone, and forms with the small articular surface situated on the side of the ulna, a kind of ring in which it easily turns; this ligament, which is called the annular, is attached to the anterior and posterior borders of this cavity, and is united externally with the external lateral ligament of the humero-ulnar articulation. In infants, this ligament, which only belongs to the superior radio-ulnar articulation, is generally less resisting than in the adult; it is the same in the tendinous fibres of the extensors, which contribute very much to increase the strength of the articulation. Hence, the dislocation of the head of the radius on the ulna is more frequent in young subjects than at a more advanced age; but what contributes still more to increase the facility with which this kind of dislocation takes place, is the proportionably smaller extent of the articular cavity at the external surface of the radius, as well as the greater length of the annular ligament, which is, consequently, more capable of extension, and also more disposed to give way. In dislocations of this kind, the displacement has almost always taken place backwards, which appears to depend on several different circumstances. In fact, it is whilst the hand is in a state of forced pronation that the head of the radius is likely to be carried behind the ulna; and, in order that it may be lodged before this bone, it

is necessary that the dislocation should take place whilst the limb is placed in a forced supination; moreover, the curvature which the two bones of the fore-arm make in their longitudinal direction, increases the power of pronation, whilst it contributes to limit supination in placing the interrosseous ligament in a state of extension: it is the same with the situation of the condyle of the humerus; for, in supination, the head of the radius rests directly on this part, whilst it is removed from it in pronation. Hence, in the first case, the force likely to carry this kind of motion beyond its natural limits, would be transmitted directly to the humerus; whilst, in the second case, ligaments only would receive it. Lastly, the pronators are so arranged as to exercise a much greater influence on the radius than the supinators, and the angle which the flexors of the fingers form with this bone, is much more open than that formed by the extensors.

In the movement of pronation, the superior extremity of the radius turns on its axis, whilst its inferior extremity turns round the ulna; consequently, the radius forms with this last bone an acute angle, and is opposed to it in nearly its whole extent, instead of being separated at its centre as in supination. It is for this reason that it has been advised to place the limb in this last position, whilst the interosseous ligament and muscles are divided, in amputating the fore-arm, according to M. J. Cloquet's plan. In sawing the bones, on the contrary, the hand should be kept prone; for, in every other position, the ulna would be found on the side of the radius, or immediately above it, and the two bones would vacillate on each other.

In the interosseous space we find two ligaments, the first, called the *round ligament*, is fixed to the anterior and superior part of the ulna below the insertion of the brachialis anticus, and descends parallel to the tendon of the biceps, to be inserted into the radius immediately below it. The *interosseous ligament* fills the whole space which exists between the two bones of the fore-arm, from the bicipital tuberosity of the radius to the articulation of the wrist. It is a thin aponeurotic membrane, and composed principally of parallel whitish

fibres, directed obliquely from above downwards, and from without inwards; we here observe several openings which allow the passage of the vessels and nerves, and its superior extremity is sloped, in order to leave between it and the round ligament, an interval for the passage of the posterior interosseous vessels. In cases of fracture of either of the bones of the fore-arm, the interosseous ligament prevents the bones being separated from each other; but nothing can counterbalance the action of the pronators, which tend to approximate the radius to the ulna. The superior extremity of the ulna being articulated by angular ginglimus with the humerus, is not susceptible of any lateral motion; but it is not the same with its carpal extremity and the ends of the radius. Hence, when these two bones are fractured, we constantly perceive a displacement of this kind: the ends of the fractured bones can also be displaced according to the direction of the axis of the limb, in consequence of the injury and the action of the flexors or extensors of the fingers; but we see very little displacement in the longitudinal direction of the limb, which depends on the insertion of the interosseous ligament into the bones of the fore-arm, nearly throughout their whole length, and on the muscles which are attached to these bones to a considerable extent, acting in the same manner on both ends. When one of the bones of the fore-arm is fractured, the only displacement which can take place is the approximation of the two fragments of the radius, or of the inferior fragment of the ulna, of the sound bone, and consequently, the diminution of the extent of the interosseous space. Hence, when the ends unite in this imperfect position, pronation, and supination, become very difficult and almost impossible. It results from the separation of the two bones of the fore-arm, that the transverse diameter of this part of the upper extremity is much larger than the antero-posterior one. Hence, in case of fracture, the bandage which is applied would augment the approximation of this bone, and consequently would be more injurious than useful, if precaution be not taken to place on the anterior and posterior surfaces of the fore-arm, graduated compresses, in

order that the pressure exercised by the bandage be greater in this than the other direction. Lastly, it is also because the antero-posterior diameter of the fore-arm is smaller than the transverse, that, in the circular amputation of this limb, the integuments should be united from before backwards.

CHAPTER XI.

REGION OF THE HAND.

§ 163. As we stated in the last chapter, the anatomy of the hand, considered in a surgical point of view, cannot be separated from that of the wrist-joint. We shall, therefore, consider here that portion of the upper extremity situated below the circular line, which we took for the inferior boundary of the middle region of the arm, and which we have placed a little above the inferior extremities of the radius and ulna. The superior and anterior portion of this region, formed by the inferior part of the fore-arm, is convex transversely, and presents towards the centre, when the hand is bent, a vertical projection formed by the tendon of the palmaris longus. Externally, we observe a groove which corresponds to the articulation of the wrist, and is bounded superiorly by the styloid process of the radius, and inferiorly by the scaphoid and trapezium. At the upper and anterior part of the hand, there are two eminences; one situated at the origin of the thumb, and called *thenar*, the other placed on the inner side, and known by the name of *hypothenar*. A depression separates these two eminences, and is continuous superiorly with a fossa, situated at the inner side of the tendon of the palmaris longus; its depth is diminished in proportion as the hand is bent backwards. This depression joins, inferiorly, another much more extensive, which occupies the middle of the *palm of the hand*. The transverse lines which separate this part of the

anterior surface of the fingers, do not correspond to the meta-carpo-phalangian articulations, but are situated about six lines below them. The articulations of the phalanges are also marked by folds of this kind, which often serve as a guide in amputation of the fingers. In fact, when the swelling is so great that the situation of the upper part of the projection formed on the dorsal surface of the fingers by the flexion of the phalanx cannot be determined with precision, M. Lisfranc recommends the incision to be made on a level with the fold of which we have been speaking, when the finger is to be amputated at the articulation of the first phalanx with the second; and half a line above, when at the articulation of the second with the third phalanx.

At the posterior surface of the limb, we find, above the wrist, a rounded prominence, formed by the inferior extremity of the ulna, and placed above a slight depression corresponding to the articulation itself. The inferior extremity of the radius is also seen through the integuments of the external side of this part. Lastly, the back of the hand is convex, and on it may be perceived the extensor tendons of the fingers.

§ 164. The skin which covers the lower extremity of the fore-arm and back of the hand, has the same appearance as in the other parts of the upper extremity; but the integuments of the palm of the hand are, in general, much thicker and more resisting, especially on the hypothenar eminence. This difference principally depends on the arrangement of the subcutaneous cellular layer. In front of the wrist-joint this layer is thin, and is formed by lamellated cellular tissue, firm and serrated, which unites the skin so closely to the subjacent parts, that, in cases of infiltration of the extremity, the effused liquid stops above this point: from which circumstance a kind of strangulation takes place, which we also observe, from the same cause, in very fat children. On the thenar eminence the subcutaneous cellular tissue becomes more loose, and, consequently, allows the integuments to be separated more easily from the parts beneath; but in the palm of the hand, it is the same as on the anterior surface of the wrist, the cellular tissue being continuous with the skin

and subcutaneous aponeurosis. On the palmar surface of the fingers, this fibro-cellular layer unites the skin very closely to the fibrous sheaths situated beneath it; but it incloses some fat, and its thickness increases towards the extremity of the fingers, and constitutes a kind of elastic cushion, which is called the pulp of the fingers. Lastly, on the posterior surface of this region, the subcutaneous cellular tissue is, in general, very loose. Hence, the skin is also very yielding, excepting at the extremity of the fingers, where it folds on itself to pass beneath the nails.

The great number of nervous filaments which are distributed to the integuments of the palmar surface of the fingers, and the dense and slightly yielding texture of this membrane, as well as of the cellular tissue which unites it to the bones and fibrous sheaths of the fingers, account for the violent pain which accompanies the development of inflammation in these parts. In fact, the increased size of the subcutaneous cellular tissue, being unable to overcome the resistance which the integuments oppose to it, produces a violent compression of the nerves placed between the bones and this firm and non-elastic sheath: hence, the pain attending the formation of a whitlow is intolerable; and when once the disease is ascertained, the integuments must be freely incised, to remove the strangulation which arises from the disproportion established between the size of the finger and its cutaneous covering.*

§ 165. At the internal and superior part of the palm of the hand, we find, immediately under the integuments, the *palmaris brevis.* It is formed of four or five small fleshy bundles, surrounded by fatty cellular tissue:

* {The great importance of early and free incisions in all the varieties of whitlow, cannot be too strongly enforced. By the prompt employment of this means, much suffering is avoided, time is saved, and the probable destruction of parts is prevented. We conceive that the disease should not be permitted to proceed to suppuration, which may always be prevented by seasonable incision, the effect of which is to relieve tension, and to empty effectually the overloaded vessels. A valuable paper on the subject, by Dr. Craigie, will be found in the Edinburgh Medical and Surgical Journal for April 1828, in which this opinion is advocated.—W.}

they are placed transversely, and arise from the anterior annular ligament, and from the internal border of the palmar aponeurosis, and terminate in the skin, near the ulnar edge of the hand. The anterior surface of this last muscle, the existence of which is very uncertain, is connected with the integuments; its posterior covers the abductor and flexor minimi digiti, the ulnar artery and nerve, and a fibrous expansion proceeding from the palmar aponeurosis, and receiving the three muscles of the hypothenar eminence. The first of these muscles is the *abductor minimi digiti:* it is a fleshy, elongated, and flattened bundle, which is attached to the os pisiforme, and the internal and superior part of the first phalanx of the little finger. The *flexor minimi digiti*, when it exists, arises from the anterior annular ligament, and the process of the unciform bone, and terminates on the tendon of the former muscle. Lastly, the *adductor minimi digiti*, the upper attachment of which is the same with the flexor proprius minimi digiti, proceeds obliquely downwards and inwards, and terminates along the inner edge of the fifth metacarpal bone; anteriorly, it is connected with the two muscles of which we have just spoken: posteriorly, it covers the last interosseous muscle, the fifth metacarpal bone, and tendon of the flexor sublimis, which goes to the little finger.

§ 166. The antibrachial aponeurosis, at the inferior extremity of the fore-arm, is attached to the radius and ulna, and is continuous with the *anterior and posterior annular ligaments.* The first of these ligaments is fixed externally to the anterior part of the trapezium and scaphoid; and internally, to the pisiforme, and process of the os unciforme, and also to the ligament which unites these two bones; inferiorly, this large fibrous band is continuous with the palmar aponeurosis. Anteriorly, it is intimately connected to the tendon of the palmaris brevis; externally, it gives attachment to a portion of the abductor brevis, opponens, and flexor brevis pollicis muscles; internally, it serves also sometimes for the insertion of the adductor minimi digiti, and receives a prolongation from the tendon of the flexor carpi ulnaris, which is fixed to the os pisiforme;

lastly, its middle part is covered by integuments, ulnar nerve, and vessels, and palmaris brevis.

The palmar aponeurosis is of a triangular form, and appears to be formed by the tendon of the palmaris longus, by oblique, fibrous bundles, proceeding from the inferior part of the antibrachial aponeurosis, and by the continuation of the transverse fibres which constitute the anterior annular ligament. At the inferior part of the metacarpus, the longitudinal fibres of this aponeurosis, which descend towards the fingers, form four distinct tongue-like processes, united by transverse fibres. Near the articulations of the metacarpus with the phalanges, each of these processes bifurcates to allow of the passage of the tendons of the flexor muscles, turns backwards, and is continuous with the inferior, transverse, metacarpal ligament. Laterally, this firm and unyielding aponeurosis is continuous with the fibrous prolongations which cover the projections formed by the muscles of the thumb and little finger, and are lost in the subcutaneous cellular tissue; anteriorly, it is connected to the common integuments by a great number of fibres.

§ 167. The *ulnar artery*, at the lower part of the forearm, proceeds into a kind of sheath formed by a fold of the antibrachial aponeurosis, descends vertically before the anterior annular ligament, passes under the palmar aponeurosis, opposite the superior extremity of the fifth metacarpal bone, and curves inwards, to form, in the palm of the hand, the *superficial palmar arch*. Lastly, having arrived at the superior extremity of the second metacarpal bone, it dips down between the soft parts which fill the first interosseal space, and communicates with the radial artery. The superficial palmar arch begins on the external side of the os pisiforme, and presents a curvature, the convexity of which is turned downwards, and gives origin to the *collateral arteries of the fingers*. These vessels are five in number; the first descends obliquely inwards, and proceeds along the internal edge of the little finger; the others descend into the interosseal spaces, as far as the heads of the bones of the metacarpus, where they bifurcate to proceed along the correspond-

ing edges of the fingers or internal edge of the thumb, and terminate in the extremity of these parts by forming anastomosing arches. The cellular tissue, which surrounds this portion of the ulnar artery, is so thick, and unites so closely the integuments to the fibro-aponeurotic layer situated above it, that, if this vessel were open, it would be very difficult to apply a ligature in this place; but the subjacent parts form a very resisting plane, so that it may be easily compressed. It is seldom necessary to tie the collateral arteries in the amputation of the fingers, for a very slight degree of pressure is sufficient to stop the flow of blood.

The *ulnar nerve*, near the wrist, divides into two branches, one of which proceeds between the inferior part of the ulna and the tendon of the flexor carpi ulnaris, to reach the back of the hand; the other, which is the largest, proceeds between the integuments and anterior annular ligament, and divides, in its turn, into two other branches, one of which passes behind the adductor minimi digiti, and becomes deep-seated; the other anastomoses with the median nerve, and furnishes the three first collateral nerves, which follow the course of the arteries of the same name, and are situated in front of them, on the lateral parts of the fingers.

§ 168. The posterior surface of the anterior annular ligament forms, with the bones of the carpus, a kind of canal, through which the tendons of nearly all the muscles on the anterior surface of the fore-arm pass. The first tendons which we meet with beneath the ligaments are the four tendons which terminate inferiorly the superficial flexor of the fingers. In the palm of the hand, these tendons separate from each other, pass into loose cellular sheaths, proceed, towards the head of the bones of the metacarpus, into the septa formed by the palmar aponeurosis; and lastly, are lodged in the sulci on the anterior surface of the phalanges, and which are converted into true canals by the fibrous sheaths of the fingers. These sheaths, formed by a very firm and serrated tissue, commence below the inferior metacarpal ligament,

from which they receive several fibres, are attached along the edges of the phalanges, and terminate at the extremity of the fingers, by interlacing with the expansion of the tendons of the flexor profundus. The anterior surface of these fibrous sheaths is connected with the integuments and collateral vessels of the fingers; posteriorly, they are separated from the tendons of the flexors by synovial membranes. Soon after they enter these sheaths, the tendons of the flexor sublimis divide in their centre, and separate, to allow of the passage of the tendons of the flexor profundus; they again unite beneath the tendons of the flexor profundus; but soon separate, to terminate on the sides of the anterior surface of the second phalanx. The tendons which terminate inferiorly the flexor profundus, pass with the preceding under the anterior annular ligament, then they both separate, and give origin towards the superior part of the hand, to four small fleshy bundles, thin and spindle-like, which terminate in the tendons of the corresponding interosseal muscles; these are called the *lumbricales.* The tendons of the flexor profundus then proceed into the fibrous sheaths of the fingers, traverse the fissure in the tendons of the flexor sublimis, and terminate in the anterior surface of the third phalanx. These tendons proceed beneath the annular ligament into the palm of the hand; they are enveloped by a synovial bursa, which unites them into a common bundle, and which forms, above and below the annular ligament, a kind of cul-de-sac. The median nerve also passes beneath the annular ligament into the palm of the hand, where it anastomoses with the ulnar nerve, and furnishes the collateral branches of the thumb, forefinger, middle finger, and inner edge of the ring finger. Hence, it happens that, when the quantity of liquid inclosed in the synovial bursa increases, it forms two tumours, one situated in the palm of the hand, the other immediately above the wrist, and that by leaning on one, the size of the other is increased. Beyond the annular ligament, the tendons of the flexors and lumbricales muscles are then united by very loose cellular tissue, and by a common synovial membrane, similar

to that of which we have just spoken. They are covered by the palmar aponeurosis, the collateral vessels and nerves of the fingers, and in their turn cover the radio-carpal articulation, the interosseal muscles, the deep palmar arch, the transverse metacarpal ligament, and the phalanges. The *tendon of the flexor longus pollicis* also passes beneath the anterior annular ligament; but it is provided with a distinct synovial bursa. It then passes obliquely outwards, between the two portions of the flexor brevis pollicis, proceeds into a fibrous sheath similar to those which we find at the anterior surface of the fingers, and terminates on the last phalanx.

§ 169. On the external side of the canal formed by the anterior annular ligament and bones of the carpus, we find a muscular projection, much more marked than that which covers the hypothenar eminence. It is formed by the abductor brevis, opponens, flexor brevis, and abductor pollicis. The *abductor brevis* is thin, triangular, and flattened; is attached to the scaphoid and superior and external part of the annular ligaments, and to the external side of the superior extremity of the first phalanx of the thumb. Anteriorly, it is covered by an expansion of the palmar aponeurosis, and by the integuments; posteriorly, it is connected with the *opponens* and flexor brevis pollicis. The first of these muscles is fixed superiorly to the annular ligament, to the external border of the groove on the os trapezium, and to an aponeurotic septum, which separates it from the flexor brevis; inferiorly, it is inserted into the whole length of the external border of the scaphoid. The anterior surface of this muscle is covered by the abductor brevis pollicis and skin; posteriorly, it corresponds to the anterior annular ligament, to the articulation of the trapezium with the first metacarpal bone, to the anterior surface of this last bone, and to the *flexor brevis pollicis*. This muscle, situated beneath the two former, is thin, and bifurcated at its extremities. It is attached superiorly to the annular ligament, the trapezium, and aponeurotic septum of which we have just spoken; inferiorly and posteriorly, to the os mag-

num and upper extremity of the third metacarpal bone; it is between these two fleshy planes, that the tendon of the flexor longus pollicis proceeds (§ 157.); lastly, after being united behind this tendon, they separate again, towards the inferior extremity of the first bone of the metacarpus, and terminate, one on the tendon of the abductor brevis, and before the superior extremity of the first phalanx of the thumb; the other, on the inner side of the same bone. Anteriorly, this muscle is covered by the tendons of the flexor longus pollicis, flexor profundus, and the two lumbricales, the inter-muscular aponeurosis, the skin, and abductor brevis; posteriorly, it is connected to the scaphoid, the two first dorsal interosseal muscles, and tendon of the flexor carpi radialis. This tendon, after having passed in front of the wrist-joint, enters into a groove in the os trapezium, and which is converted into a canal by a ligamentous sheath, which passes from the antibrachial aponeurosis and external side of the groove, and which is attached to the trapezoid and second bone of the metacarpus; it then dips down outwards and backwards, and terminates on the head of the second metacarpal bone. The *abductor pollicis* is frequently united by its outer edge to the flexor brevis; it is inserted into the anterior surface of the third bone of the metacarpus, and into the internal and superior part of the first phalanx of the thumb; lastly, it corresponds anteriorly with the tendons of the flexor profundus, to the two first lumbricales, and to the skin; and posteriorly, to the three first interosseal muscles, and to the skin. The different muscles of which we have spoken contribute very much to strengthen the metacarpal articulation of the thumb, as will be seen on describing that part.

§ 170. At the posterior surface of the wrist, the antibrachial aponeurosis proceeds in the same manner as in front of the radio-carpal articulation, and after receiving some transverse fibres which are attached to the external and inferior part of the radius, to the edge of the ulna, the tuberosity of the fifth metacarpal bone, and to the os pisiforme; it constitutes the *posterior annular ligament*. Below the wrist, it is continuous with

a cellulo-aponeurotic layer, which covers the back of the hand, and furnishes to the tendons of the external muscles of the fingers a common covering. The posterior surface of this ligament is covered by the integuments and veins which arise from the back of the hand, and proceed to the back part of the fore-arm; its anterior surface gives origin to fibres which form septa between the tendons that pass beneath this ligament. The first of these grooves transmits the tendons of the abductor longus and extensor primi internodii. The second groove is perpendicular, and allows of the passage of the tendons of the two extensores carpi radiales. The third, taking an oblique direction, contains the tendon of the extensor internodii secundi; the fourth fibrous canal, much larger than the others, extends transversely, and lodges the tendons of the extensor communis and indicator; the fifth sheath is situated between the radius and ulna, and receives the tendon of the extensor minimi digiti; lastly, a sixth groove extends from the posterior part of the small head of the ulna to the styloid process of the same bone, and incloses the tendon of the extensor carpi ulnaris. Each of these tendons is surrounded by a synovial membrane, by which its movements beneath the annular ligament are facilitated. The tendons of the extensores digitorum have a common bursa mucosa; in the natural state, it only encloses a small quantity of liquid; but it sometimes happens that this secretion takes place in preternatural quantity, and produces a tumour on the upper part of the wrist, which, in general, causes but little inconvenience.

§ 171. The *tendon of the abductor longus pollicis*, on leaving the sheath furnished it by the posterior annular ligament, divides into two or three portions, and goes to be inserted into the external part of the superior extremity of the first metacarpal bone. The tendon of the extensor primi internodii separates from this last, descends behind the bone which we last mentioned, and terminates in the posterior and superior part of the first phalanx of the thumb. That of the extensor secundi internodii descends backwards and to the inner side of the first bone of the metacarpus, joins, near the

articulation of this bone with the first phalanx, the tendon of the extensor primi, and is inserted into the posterior part of the last phalanx of the thumb. The tendons of the two extensores carpi radiales cross the tendon of the extensor longus pollicis, and are inserted into the superior extremity of the second and third metacarpal bones. The tendons of the extensor communis digitorum, after having traversed the annular sheath, separate from each other. After joining the tendons of the lumbricales and interosseal muscles below the metacarpal phalangian articulation, they enlarge and form a kind of aponeurosis, which covers the whole posterior surface of the fingers, and divides into three portions, one of which passes behind the articulation of the first and second phalanges, to the latter of which it is attached; the two others pass on the lateral parts of the same articulation, then unite, and form, lastly, a flattened tendon, which is inserted into the posterior and superior part of the third phalanx. The tendon of the extensor digiti minimi unites externally to the fourth tendon of the extensor communis, and terminates on the little finger in the same manner as those which we have mentioned. The tendon of the indicator is united with that which the extensor communis sends to this finger, behind the second metacarpo-phalangian articulation. Lastly, the tendon of the extensor carpi ulnaris dips beneath the abductor digiti minimi, and is inserted into the superior extremity of the fifth bone of the metacarpus.

§ 172. The *radial artery*, which, as we have seen, descends vertically under the antibrachial aponeurosis, and before the pronator quadratus and anterior surface of the radius (§ 153.), gives origin near the wrist to a branch, which descends in front of the anterior annular ligament, and anastomoses with the superficial palmar arch. This vessel then turns towards the outer side of the hand, passes beneath the three extensor tendons of the thumb, and dips down between the superior extremities of the metacarpal bones of the thumb and fore-finger, to proceed into the palm of the hand. Here it divides into two branches, one of which descends between the flexor primi internodii and abduc-

tor indicis, then along the inner edge of the thumb and outer edge of the fore-finger, and anastomoses, lastly, with the collateral arteries. The second branch of the radial artery proceeds transversely to very near the ring finger, describing a slight curve, the convexity of which is directed downwards; this is called the *deep palmar arch*. Towards the internal border of the hand, this vascular arch terminates beneath the flexor and adductor digiti minimi, anastomosing with a branch of the ulnar artery; in the remainder of its course, it is covered by the abductor pollicis, by the tendons of the flexors of the fingers and lumbricales, and rests on the bones of the metacarpus and interosseous muscles. The branches which arise in this part are divided into superior, inferior, anterior, and posterior. These last, which are called the *arteriæ perforantes*, traverse the interossei muscles, and ramify on the back of the hand: of the remainder, their caliber is too small to have any influence on the surgical operations performed in this part.

When aneurisms are developed on the superior part of the fore-arm, the cure may be effected by tying the diseased artery, at a greater or less distance from the tumour, between it and the heart. But the case is different when an aneurism forms at the hand or wrist, for the radial and ulnar arteries communicate with each other, in the palm of the hand, by so numerous and so direct anastomoses, that the recurrent circulation would be sufficient to keep up the disease, even if a ligature were put on the artery at a moderate distance from the tumour. It is for this reason, that, in cases of this kind, it has been advised to tie the artery both above and below the aneurismal sac; but, according to Hodgson, it is sufficient to place only one ligature, provided it be very near the tumour, in order that the blood may not penetrate it directly by the anastomotic branches situated between it and the obliterated point; for then the blood, coming from the lower extremity of the vessel, not being able to advance, coagulates in it. The superficial situation of the ulnar and radial arteries, near the wrist-joint, and the resistance of the osseous plane on which they rest, are circumstances

favourable to the treatment of aneurisms in the hand, by compression. The ligature of these vessels may be easily applied towards the lower extremity of the fore-arm, and if the radial artery requires to be secured after it has quitted the anterior part of the wrist, it may be done by dividing the integuments and subcutaneous cellular tissue, between the tendons of the extensores longus and primi internodii, below the posterior annular ligament, and at the bottom of a fossa, which we have mentioned above (§ 163). Care must be taken, however, not to include in the ligature a branch of the external cutaneous nerve, which proceeds on the outer side of the artery.

§ 173. Between the bones of the metacarpus and beneath the deep palmar arch there are three muscles, which are called the palmar interosseous, on account of their situation; these are, the *adductor indicis*, which is attached to the inner side of the second metacarpal bone; the *abductor digiti annularis*, situated between the third and fourth metacarpal bones; and the *abductor digiti minimi*, which is attached to the outer surface of the fifth metacarpal bone. These muscles do not present any thing remarkable; they correspond posteriorly to the dorsal interosseous, which are four in number: the first is the *abductor indicis*, which is attached to the outer edge of the second, and inner edge of the first, metacarpal bone, and leaving between these points of attachment a space for the passage of the radial artery. The *abductor* and the *adductor digiti medii* occupy the second and third interosseous space; then the last of these muscles, the *adductor digiti annularis*, is situated between the fourth and fifth bones of the metacarpus. All the interosseous muscles terminate inferiorly in tendons, which join the tendons of the extensor digitorum, and send aponeurotic prolongations on the superior extremities of the first phalanges, or are attached directly to this bone. Lastly, the dorsal interosseous muscles are covered posteriorly by a fibrous membrane, which is attached to the posterior surface of the bones of the metacarpus, and united inferiorly to the superficial aponeurosis of the back of the hand.

§ 174. The frame-work of that portion of the upper

extremity which we are now considering is formed by the inferior extremities of the two bones of the forearm, the eight bones of the carpus, the five metacarpal bones, and fourteen phalanges. The *carpal extremity of the radius* is the thickest part of this bone; it is almost quadrangular, and presents an articular surface, divided into two lateral portions by a slightly projecting line, which traverses it from before to behind; the external surface is triangular, and somewhat extensive, is articulated with the scaphoid; the internal, square, and less elongated, is joined to the os lunare. The anterior surface of the inferior extremity of the radius is plane, and gives attachment to the anterior ligament of the wrist-joint; the posterior is deepened by two vertical fossæ, in which the tendons of the extensor longus pollicis, extensor communis digitorum, and indicator pass; externally, it also presents two grooves, one for the tendons of the extensores carpi radialis; the other for those of the abductor longus and extensor primi internodii; the ridge which separates them terminates inferiorly in an eminence called the styloid process of the radius: lastly, the internal surface of the inferior extremity of this bone is deepened by an oblong cavity, which is articulated with *the small head of the ulna.* This name is given to one of the two eminences which terminate the ulna inferiorly; it is rounded, covered by cartilage; and, placed at the outer side of the other eminence, covering the styloid process of the ulna, and being a little in front of it: this latter eminence is more projecting, and gives attachment to the internal lateral ligament of the joint. Posteriorly, these two eminences are separated by a groove lodging the tendon of the extensor carpi ulnaris.

The *inferior articulation of the ulna with the radius* owes its strength almost entirely to a triangular fibrocartilaginous structure, placed transversely between the carpal extremity of these two bones. At its apex it is fixed into a small groove, situated between the articular surface of the ulna and its styloid process; its base is inserted into the projecting edge which separates the inferior extremity of the radius from its inner side. The superior surface of this cartilage is concave,

and connected with the head of the ulna; its inferior surface, equally concave, is contiguous to the os cuneiforme. Some ligamentous fibres, placed before and behind this articulation, strengthen the synovial membrane which lines it, and constitute what is called the capsular ligament. When the hand is carried into a forced state of pronation or supination, this ligament is always put on the stretch, and would soon give way, did not the triangular ligament limit its motion; in fact, in order that the luxation of the small head of the ulna, on the radius, may take place, it is necessary that the ligament be torn or elongated very much, in order for it to pass behind this bony eminence. Dislocations of this kind are very rare, and those in which the ulna is placed before the radius are still less frequent than those behind; owing to the situation of the pronators, which oppose the action of the causes tending to produce this displacement.

§ 175. The *carpus* is formed of eight small bones, firmly united to each other, and placed in two rows, but three are only articulated to those of the fore-arm: these are the scaphoid, the lunar, and cuneiform; for the pisiform, which completes the first row, is situated before the cuneiform, and not by its side. These three bones form an oblong, convex articular surface, which is received into the cavity on the inferior extremity of the radius; the space between the ulna and these bones is filled by interarticular cartilage. The styloid process of the radius descends on the external side of the scaphoid, and is united to this bone by the external lateral ligament. The styloid process of the ulna also proceeds before the os cuneiforme, and is fixed to it by a fibrous bundle, which proceeds obliquely, from above downwards and from within forwards, from the top of this eminence, on the internal side of the os cuneiforme; this is called the internal lateral ligament. The styloid process of the radius descends lower than that of the ulna. Hence, in amputation of the wrist-joint, the articulation must be opened from this side; for, in carrying the instrument under the styloid process of the ulna, it would fall between the first and second row of the bones of the carpus. It is also on account of the

projection which these two processes form, and of the curvature, which the joint presents posteriorly, that we cannot, in the operation which I have just mentioned, penetrate into the articulation in this last direction.

Behind the radio-carpal articulation, we find a ligament which is fixed to the inferior extremity of the radius, and descends obliquely inwards to be attached to the posterior parts of the lunar and cuneiform bones. In front, this articulation is also provided with a ligament which descends from the radius on the scaphoid, lunar, and cuneiform bones. But those tendons, which are situated before and behind the wrist, chiefly contribute to prevent dislocations in these two directions. In fact, these tendons, collected together in fasciculi, and fixed to the bones of this part by the annular ligaments, naturally oppose every thing which tends to change the natural relations of the articular surfaces. The anterior or posterior dislocation of the wrist is that which most frequently occurs; but these accidents are comparatively rare. The lateral dislocations are to be met with; but the great lateral expansion of the articular surfaces, as well as the situation of the styloid processes, render them very difficult, and in this direction the hand is seldom required to sustain any great force.

The second row of the bones of the carpus is formed by the trapezium, trapezoid, magnum and unciform. A fibrous layer surrounds all these bones as well as those of the first rows, and appears to be a continuation of the ligaments of the wrist-joint. Below it we find several small fibrous bundles, which, from their situation, may be divided into dorsal and palmar. The union of the bones of the carpus with each other is so firm, and so strong, and their power of motion so limited, that their dislocation appears almost impossible; the head of the os magnum may, however, escape from the articular cavity formed by the scaphoid and lunar. In fact, the bones of the second row of the carpus may be slightly flexed on the first row, and the head of the magnum, ascending higher than the three others placed in the same line, may experience a considerable displacement. In fact, it proceeds backwards, raises the thin capsule

which surrounds it, and ruptures it, if this motion be carried too far.

The posterior surface of the carpus is very smooth and rather convex; anteriorly, it is, on the contrary, concave in the centre, and presents on each side two eminences which still further increase the depth of the sulcus, which they terminate laterally, and which lodges the tendons of the flexors. The two internal eminences are formed by the pisiform and unciform, the external by the scaphoid and trapezium. The pisiform is fixed to the unciform and fifth bone of the metacarpus by ligaments; but is situated on the cuneiforme: from this arrangement, it is evident that, in amputation of the wrist, if the instrument be carried too deeply, in making the internal flap, the operator would run the risk of separating this bone, and of leaving it in the flap, or of being stopped by the projection of the trapezium.

§ 176. The *bones of the metacarpus*, five in number, form a continuation of the carpus, and are placed parallel, the one by the side of the other, and almost in the same line; excepting the first, which is situated rather more anteriorly than the other. They are convex behind, concave before, and divided into a body, and two extremities, the inferior of which is called the hand. The metacarpal bone of the thumb is larger but shorter than the others; its upper extremity is provided with a smooth surface, by which it is articulated with the inferior surface of the trapezium. This arthrodial articulation is only surrounded with a capsular ligament. Hence, dislocation of this joint more frequently occurs than that of the other carpo-metacarpian articulations. Dislocation of the thumb backwards is the only one known; for, although the joint possesses the power of extension, flexion, abduction, and adduction, still different circumstances prevent the dislocation forwards, inwards, or outwards. The flexor brevis and opponens pollicis prevent the anterior dislocation; the dislocation inwards can only take place when the thumb is carried to the greatest point of abduction, which, however, is prevented by the muscles situated between the first and second metacarpal bones, and by the resistance which the latter bone offers the former, when it is carried too

far internally. Lastly, adduction is prevented by the same bone, before it is carried so far as to render dislocation outwards possible.

Amputation of the thumb, at the carpo-metacarpian articulation, is easy, on account of the great extent of the first interosseal space, and the flattened articular surface by which the first bone of the metacarpus is joined to the trapezium. In this operation the radial artery is almost always divided at the point where it traverses the first interosseal space, to get into the palm of the hand: it is situated at the deepest part of the wound. The spaces between the other metacarpal bones are filled by the interosseus muscles. On the superior extremity of the metacarpal bone of the forefinger, there is a concave surface which is articulated with the trapezoid; externally it presents a second articular surface, which is joined to the trapezium, and internally there is a third by which it is articulated with the os magnum. The third metacarpal bone is terminated superiorly by one plane articular surface, which is united to the magnum. The carpal extremity of the fourth presents two surfaces. the most external of the two for articulation with the os unciforme, and the external and posterior for junction with the magnum. Lastly, the fifth metacarpal bone is terminated superiorly by one articular surface, by means of which this bone is joined to the os unciforme. These different articulations are provided with dorsal and palmar ligaments, which are continued from the bones of the carpus to those of the metacarpus, and allow only of very limited flexion and extension; consequently, we never find them dislocated. The amputation of the fifth metacarpal bone is more difficult than that of the first, on account of the narrowness of the last interosseal space: the amputation of the three others is still more difficult, on account of the intimate nature of their connexion with the bones of the carpus. The inferior extremity of each metacarpal bone is round, compressed from side to side, and convex from before to behind. Its articular surface, covered with cartilage for junction with the phalanges, is broader before than behind, and

on each side there is a depression for the attachment of the lateral ligaments.

§ 177. The *phalanges*, flattened from before to behind, convex posteriorly and concave anteriorly, are broader at their upper than their lower extremity. Each finger has three phalanges, the thumb only two. They are divided into rows, the phalanges nearest the metacarpus constituting the first row, the next the second, &c. Their metacarpal extremity is of a quadrilateral form, and presents a superficial cavity for articulation of the heads of the bones of the metacarpus; the lateral ligaments which are attached to the sides of each metacarpal bone, and to the sides of the upper extremity of the corresponding phalanx, are the principal connexions by which these bones are joined together. But the tendons of the extensor and flexor muscles, together with those of the interosseous and lumbricales on the sides, contribute very much to strengthen the joint. The metacarpo-phalangian articulation of the thumb is also protected by the abductor opponens, flexor brevis, and adductor pollicis; that of the little finger, by the flexor proprius, and adductor muscles. These bones may, nevertheless, be dislocated forwards, backwards, or laterally: dislocation forwards is certainly very difficult, on account of the arrangement of the head of the metacarpal bone; indeed, this eminence is prolonged so far forwards, (especially in the fourth and fifth bones,) that the first phalanx may be bent almost to such a degree, as to rest on the palm of the hand, and still be in contact with the head of the metacarpal bone. As to the lateral dislocation, it can be easily conceived how this so rarely happens, when we consider the strength of the lateral ligaments, and the support which the fingers afford each other. Dislocation backwards is the one most commonly observed: this occurs to the thumb most frequently, and may take place without the lateral ligaments being ruptured.* If the thumb

* {Very great difficulty is sometimes experienced in attempting to reduce this dislocation, and Charles Bell says, "the thumb has been absolutely torn off at the second joint, in the attempt to reduce the dislocation of the first!" Conceiving the difficulty to

be violently extended, the base of the first phalanx slips behind, and ruptures the capsular ligament; it also distends the tendons of the extensor muscles, passes behind the head of the metacarpal bone, and merely changes the direction of the metacarpal ligaments. In general, this dislocation is easily reduced, but this is not the case when it has been of long standing, on account of the resistance offered by the powerful muscles surrounding the joint.

In amputating the fingers at their articulation with the carpus, according to the plan of M. Lisfranc, it is important to bear in mind that the upper extremity of the phalanges presents, in the palmar surface, a slight projection against which the instrument is stopped, immediately in front of the articulation; and that, in order to penetrate into the joint, the knife must be directed perpendicular to the axis of the finger. Lastly, it is equally important to recollect that the carpo-metacarpian articulation of the little finger is placed in the same line as that of the first phalanx of the thumb with the last.

The inferior extremity of the first phalanges is bounded by two small condyles, separated from each other by a small sulcus, and projecting farther anteriorly than posteriorly; these articular surfaces correspond to two others, placed at the superior extremity of the next phalanx—the articulation of these bones is strengthened by ligaments, differing in no respect from those which extend from the phalanges to the carpus, and by the tendons of the extensor muscles of the fingers. Most of the remarks which we made above, when speaking of the dislocations of the phalanges with the bones of the metacarpus, are applicable to the second with the first phalanges, therefore we shall not repeat them. The last phalanges present nothing remarkable:

arise from the head of the bone being pushed between the ligaments, in which situation the ligaments bind the bones together, and keep them locked, he long since proposed, (when the proper attempts at reduction had failed,) to insinuate a couching needle obliquely under the skin, and to cut one of the lateral ligaments, after which the bone may readily be restored to its place, and the joint should be supported by a splint and bandage.—W.}

the posterior surface is convex, and covered with nails, the anterior concave, and gives insertion to the tendon of the flexor profundus.

CHAPTER XII.

ANTERIOR REGION OF THE ABDOMEN.

§ 178. The abdomen is the part of the trunk situated below the thorax, and terminated inferiorly by the pelvis and lower extremities. Its general form is oblong from above downwards, and compressed from before to behind. In women it is much larger below than above; in men this is less marked, and its depth is less, compared with the size of the trunk; in females, therefore, the cavity of the abdomen is larger than in men. This cavity, of an ovoid shape, is exactly filled by the viscera which belong to the organs of digestion, secretion of urine, generation, &c., and its parietes are formed in front by the integuments and the proper muscles of the abdomen, behind by the same muscles and the vertebral column, above by the diaphragm, and below by the pelvis and soft parts which fill its different openings. Lastly, in order to point out with more accuracy the situation of the different viscera lodged in the abdomen, this part of the trunk has been divided into nine regions: for this purpose, two horizontal lines are drawn, one just below the last ribs, the other just above the hips; these are then intersected at right angles by two vertical lines drawn from the centre of the costal cartilages on each side of the sternum, to the middle part of the groin. By this plan the abdomen is divided into three zones, each of which is again subdivided into a central and two lateral portions. The middle portion of the superior zone is called the epigastric, the two lateral the hypochondriac regions. The middle zone is subdivided into the central or umbilical and the two lumbar, whilst the inferior contains the hypogastric in

the centre, and the two inguinal on the sides. These divisions are generally adopted, and we shall be compelled frequently to employ them; but they do not appear well suited for our examination of the abdomen, for their use would cause frequent repetitions, and compel us to separate the description of parts, which, in a surgical point of view, are intimately connected with each other. We shall find it more advantageous to study at the same time all the parts to which the same considerations are applicable, and not unnecessarily multiply arbitrary divisions. On this account we shall merely suppose the abdomen divided into three regions, an anterior, a posterior and superior, and an inferior.

The anterior region of the abdomen is bounded superiorly by the sternum and ribs, anteriorly by the median line of the body, and externally by the continuation of the fictitious line, which separates the anterior and posterior thoracic regions, and terminates at the middle of the crista ilii. Inferiorly, the natural limit of this region would be the fold of the groin which separates the trunk from the thigh; but as there exists in this part a canal, which communicates superiorly with the cavity of the abdomen, and the lower opening of which is situated at a certain distance below this oblique line, we must, therefore, in this division of the body, include all the parts which contribute to form this canal.

§ 179. The anterior wall of the abdomen, formed entirely of soft parts, is the longest of all, and presents remarkable differences, not only according to the age, sex, and individual, but also according to the position of the body. In very thin persons, for instance, the belly, instead of being convex, may be flat or even concave, which may be still further increased by the contraction of the muscles of this part. In young children the abdomen is much more prominent than in adults. Lastly, its convexity is always diminished in the horizontal position, and increased in the erect or kneeling posture. It is important to bear in mind the changes which the different positions of the body may produce in the form of the anterior walls of the abdomen, and

the influence of these positions on the relaxation or contraction of the muscles which form it, when we are attempting to reduce a hernia, or are examining the state of the abdominal viscera. In order to return the intestines which have escaped from the cavity of the abdomen, by a natural or accidental opening of its parietes, as well as to facilitate the examination of the viscera, the patient must not only be placed in a horizontal position, but the head, chest, and thighs, must be raised so as to approximate as much as possible the attachment of the abdominal muscles. In an adult subject thus situated, the left lobe of the liver may be felt through the abdominal parietes in the epigastric region; but in the hypochondriac, the inferior edge of this viscus does not descend in the natural state below the edge of the false ribs. If, on the contrary, the person be placed in the vertical position, the liver generally descends at least two inches lower. At the superior part of this region we observe, on the median line, a depression somewhat broad and deep, corresponding to the epigastrium; lower down we find the navel or umbilicus, a rounded cicatrix which is formed after the falling of the umbilical cord, and the depth of which increases in proportion to the age and size of the individual. Towards the lower and lateral part of the abdomen, we observe the projection formed by the os ilii, and an oblique fold, which extends from the anterior superior spinous process of this bone to the pubis, the size of which is increased when the thigh is bent; this is the fold of the groin. On examining it from the outer to the inner side, there may be distinguished through the integuments, first, a projection, which is continuous with the spine of the ilium, and which is formed by the attachment of the sartorius muscle; then, a nearly plane surface; after this, two depressions. The first of these depressions, at the bottom of which the pulsation of the femoral artery can be felt, is filled with lymphatic ganglia; the second is larger than the former, but is in part continuous with it. It is bounded internally by the pubis, and adductor longus, and above by the crural arch, a ligamentous band extending between the spine of the ilium and the tuberosity

of the pubis. Inferiorly, these depressions are continuous with a slightly concave triangular space comprised between the crural arch, the sartorius, and adductor longus, and which has been compared to the axilla; the situation, form, and parts contained in it, justify, in some degree, the comparison; it is, however, not so deep.

§ 180. The skin, which covers the anterior wall of the abdomen, is not so thick in front as it is laterally; it is yielding, however, throughout; in women who have had many children, it often presents transverse folds, especially towards the inferior part of the belly. On the median line, and around the umbilicus, the integuments are intimately connected to the subjacent parts. Below this spot, they begin to be covered with hairs, which are found in great quantities in front of the pubis, and extend to the internal part of the groin, where the skin is fine and soft. When an operation is about to be performed in any place which is covered with hairs, they must be carefully shaved off. In fact, if they are left, they will not only blunt the knife and prevent the surgeon from making a neat and regular incision, but render the application of adhesive plaster very difficult, the dressings very painful, and will impede the cure of the wound by the first intention.

§ 181. The subcutaneous cellular tissue of the anterior wall of the abdomen forms, in general, two very distinct layers. The first incloses adipose vesicules, always more numerous on the groin than on the umbilicus and epigastrium. The projection, which is observed in front of the pubis in women, and which is called the mons veneris, is principally formed by the fat which accumulates in the subcutaneous cellular tissue of this part. Sometimes it is in such quantities as to form a transverse fold of the skin, a fold which covers the groin and external parts of generation, and which, when greatly developed, forms the tablier* of

* Blumenbach is of opinion that the tablier, ascribed to the female Hottentots, is nothing but an artificial elongation of the labia, "Nymphas in Hottentoticis mulieribus in dactyliformes appendiculas abire nonnulli aiunt. Rectius tamen hic *sinus pudoris*, ut Linnæus vocabat, in elongatione ipsorum labiorum consistere videtur

the Hottentot women. The second layer of cellular tissue is membranous, and forms the *superficial fascia.* The existence of this cellulo-aponeurotic layer was first noticed in the inguinal region; but, as Colles observes, it may be traced with a little care, on the thighs, chest, and even up to the neck, where it is continuous with the membrane which covers the platysma myoides, parotid gland, &c. (vide §§ 51 and 64). In this, as in the other parts of the body, the nature of the superficial fascia varies in different people; formed principally by condensed cellular tissue, it has the appearance of a true aponeurosis in old and thin persons, and in those who have been affected with old, large herniæ. In children, or very fat persons, or where infiltration exists, the fascia can scarcely be distinguished from the cellular tissue which covers it. Superiorly, it is continuous with the deep layer of cellular tissue which covers the chest; laterally, it gradually loses its aponeurotic appearance, and degenerates into common cellular tissue, and on the median line becomes continuous with that of the opposite side. In front of the abdomen, this membrane is white, transparent, and apparently homogeneous; but towards the inguinal region, a few albugineous fibres are generally seen. In front of the pubis, it sends several fibrous layers to the skin of the penis, and in females it is continuous with an analogous

quam quidem artificio deberi fertur, et quæ fabuloso ventrali cutaneo ansam præbuit, quod ab abdomine dependens obscenas harum feminarum partes obtegere creduli auctores putabant.—*De Gen. Hum. Var.* sect. 68.

But more careful and accurate examinations, both in Europe and Africa, have proved most clearly, that the tablier or apron consists of an elongation of the nymphæ, and that the formation is natural. Much interesting information on this subject will be found in *Lawrence's Lectures on Physiology.*

Voltaire, in his *Lettres d'Amabed,* Lettre 40, assuming the existence of the *tablier,* deduces from it an argument to show the absurdity of supposing that the Hottentots and Europeans descend from the same progenitor :—"*Au pays des Hottentots la nature a donné aux femmes un tablier que forme leur peau ; ce tablier couvre leur joyau, dont les Hottentots sont idolâtres, et pour lequel ils font des madrigaux et des chansons. Plus je réfléchis sur la couleur de ces peuples, sur leur figure, sur le tablier de leurs dames, plus je suis convaincu que cette race ne peut avoir le même origine que nous.*"—T.

tissue in the substance of the greater labia. In man, the superficial fascia then proceeds on the spermatic cord, surrounds the inguinal ring, without intimately adhering to it, and forms a kind of thin cul-de-sac, transparent, and cellular, which descends to the bottom of the scrotum, and lodges the tunica vaginalis, the testicle, and spermatic cord. At some distance below the ring, this sheath is continuous with a very fine cellular expansion, which arises from the edges of this opening, and which surrounds the spermatic cord; lower down, it is connected to the fibrous fascia, which fixes the testicle to the scrotum and ramus of the ischium. On the outside of the inguinal ring, the superficial fascia divides into two layers; the one, superficial, passes in front of the crural arch, is connected internally to the ascending branch of the ischium, and covers the crural aponeurosis. The other, deeper, is united to the crural arch and to the portion of the aponeurosis situated immediately beneath it; it is on this account that Scarpa, in describing the superficial fascia, regarded it as a prolongation of this fibrous sheath.

It is under the superficial fascia, or in its substance, that the greater part of the subcutaneous vessels of this region is situated. That which deserves our attention is the *inguinal artery*. It arises from the femoral immediately below the crural arch, and ascends obliquely outwards on a level with the umbilicus, where it anastomoses with the epigastric and internal mammary. The caliber of this vessel is, in general, too small to cause any serious inconvenience when it is wounded. When it is divided, which often happens in operations for crural hernia, &c., it is better instantly to tie it, lest the ends of the divided vessel should retract between the layers of the fascia, and escape our view. Two or three small arteries pass transversely either above or below the spermatic cord, from the femoral artery to the penis, and are accompanied by more numerous and larger veins. At about an inch and a quarter from the tuberosity of the pubis, one of the branches of the external pudic arteries, with a very large vein which descends from the umbilical region, passes on the edge of the crural arch, and opens into

the femoral. These vessels are frequently divided in the operation for inguinal and crural herniæ, and the flow of blood consequent on their division, might be the cause of considerable inconvenience to the surgeon, if he were ignorant whence it proceeded. Lastly, at the superior and internal part of the thigh, we find the internal *vena saphæna*, which passes into the femoral immediately below the crural arch. The *superficial lymphatic glands of the groin* are also situated in this spot. These ganglia receive the greater part of the subcutaneous lymphatic vessels of the lower extremity, of the genital organs, and of the anterior parietes of the abdomen. Each of them is surrounded by a layer of superficial fascia, and these layers form distinct envelopements: one, containing three or four of these bodies, surrounds the superior extremity of the internal saphæna vein; the other, situated higher up, and formed by six or eight ganglia, proceeds obliquely upwards and outwards towards the spine of the ilium. From the situation of these bodies, it is evident, that they must be compressed by the superficial fascia, whenever the trunk is extended on the thighs. Hence, when they are swollen and inflamed, this position is extremely painful, and the patient experiences decided relief by the flexion of the lower extremities.

§ 182. Immediately beneath the superficial fascia the *obliquus externus abdominis* is situated, which arises from the external surface of the eight last ribs below the points of insertion of the pectoralis major, serratus magnus, and latissimus dorsi; thence its fleshy fibres proceed obliquely downwards and forwards, and terminate laterally by short aponeurotic fibres, which are inserted into the two anterior thirds of the crista of the ilium, and anteriorly by a large and strong aponeurosis, which is connected on the median line with that of the opposite side, and is inserted into the pubis. The fleshy portion of this muscle is very intimately connected to the superficial fascia, but its aponeurotic portion is separated from it by very loose cellular tissue. This aponeurosis is much thicker and firmer towards the fold of the groin than above the umbilicus. Hence, during dissection, it becomes quite

opaque in this part, whilst higher up it preserves its transparency, so that the fleshy fibres of the muscle which it covers may be seen through it. At the superior part of this region, it is only formed by parallel fibres, which proceed obliquely downwards and forwards; but at its inferior part, some transverse fibres are observed, which cross the former at right angles, and the strength of which varies very much in different individuals. At about an inch and a half from the pubis, this whitish membrane divides into two bands, which are called the *pillars of the inguinal ring*. The one, internal and superior, large, thin, and flattened, is inserted into the pubis, and interlaces with that of the opposite side. The other, external and inferior, round and much stronger than the preceding, is attached to the spine and the crista of the pubis. To within near an inch of the pubis, these two fibrous bundles are firmly connected by transverse bands and some semicircular fibres; but, below this point, they give passage to the spermatic cord in the male, and the round ligament of the uterus in the female, and thus constitute the inguinal ring. This opening, however, is not circular; it is rather triangular, and its transverse diameter from one pillar to the other is only half an inch, whilst its length from the pubis to the transverse bundle is about an inch. The opening is directed obliquely upwards and outwards; its centre is situated an inch and a quarter from the pubis, and its size, which differs in different individuals, is always larger in men than women. Lastly, from its edge a cellular prolongation is given off, which, in the natural state, is thin and transparent, but in certain cases of herniæ may become so thickened as completely to hide the ring, and form round the tumour a kind of aponeurotic sheath, which sometimes descends to an inch and a half below this opening.

§ 183. The external and lower pillar of the inguinal ring passes from without inwards and below upwards, so as to form a groove, in the anterior part of which the spermatic cord descends. Internally and superiorly this aponeurosis is continuous with the transverse fascia or inguinal portion of the pelvic aponeurosis. Its

inferior edge extends obliquely from the anterior and superior spine of the ilium to the pubis, and is called *Poupart's ligament.* It leaves between it and the edge of the pelvis a rather large space, which is in part filled by muscles and aponeuroses, and giving passage to the femoral vessels; it is called the *crural arch.* This ligament is inserted into the spine and crista of the pubis by means of a triangular fibrous expansion, which is given off from its posterior edge, to be attached along this crista, and fills the space which exists between the crural arch, pubis, and femoral vessels; it is the third attachment of the external oblique, according to English anatomists. It is continuous with the transverse fascia, and contributes to form the fold known by the name of Gimbernat's ligament. Inferiorly, Poupart's ligament is continuous with the *crural aponeurosis* or *fascia lata*, a thick and firm fibrous membrane, which is also attached to the pubis and the crista ilii, and serves as a sheath or covering to the lower extremity. The tensor muscle of this aponeurosis is situated on the sides of the hip between the layers of the fascia; superiorly, it is attached to the anterior and superior spinous process of the ilium, from which point its fleshy fibres terminate in the aponeurosis. A little more anteriorly, we observe several small openings for the passage of the subcutaneous vessels, and that it is closely connected to the outer four-fifths of Poupart's ligament. About an inch from the spine of the pubis, we observe the inferior opening of the crural canal or oval fossa which gives passage to the vena saphæna interna. According to the investigations of M. J. Cloquet, it appears that in women this opening is nearer the crural arch than in men; its vertical diameter is from six to ten lines in length, and transverse from three to seven. Lastly, its superior extremity is sometimes situated close to the crural arch, at other times it is separated to the distance of twelve or eighteen lines. The external edge of this opening is only continuous with the cellular tissue which surrounds the vena saphæna, and appears formed of a falciform fold, the lower extremity of which is thick and distinct. It is situated in the angle which this vessel and the femoral

vein leave between them just before their point of union, and then ascends inwards to terminate on the inner portion of the crural aponeurosis. The upper extremity of the outer edge of this opening is continued in the form of a thin and narrow process, which bends on itself and dips beneath the crural arch, to become continuous with Gimbernat's ligament. The portion of the crural aponeurosis which constitutes the inner edge of this opening, does not terminate in a fold similar to the upper, but is continued upwards and outwards, and passes beneath the femoral vessels. At this spot it becomes thinner and less firm, receives a point of attachment from Gimbernat's ligament, and proceeds beneath the crural arch to be continuous in the interior of the pelvis with the pelvic aponeurosis. Lastly, it terminates externally by joining the outer portion of the crural aponeurosis in front of the sartorius muscle. In consequence of the arrangement which we have just mentioned, most anatomists have described this membrane as formed superiorly of two distinct layers; the one, external and superficial, which is attached to Poupart's ligament; the other, internal and deeper, which passes beneath the former, to be attached to the pubis, and be continued beneath the crural arch. We shall return to the space comprised between the upper extremity of the outer edge of the foramen, which gives passage to the vena saphæna (falciform process of the iliac portion of the *fascia lata* of Burns) and the process of the inner edge of this opening, which lodges the femoral vessels, and constitutes the crural canal, when we have considered the parts which form its upper opening.

§ 184. Beneath the external we find the *internal oblique muscle.* It arises by an aponeurosis common to it, and the muscles of the back from the three anterior fourths of the crista ilii; and lastly, from a kind of depression produced by the fold from the inner edge of Poupart's ligament: it then proceeds obliquely upwards and forwards, and terminates on the three last ribs, and an aponeurosis, which at the anterior part of the abdomen* divides into two layers; one of the layers passes

* {At the *linea semilunaris.*—W.}

Y

before the rectus, the other behind it, and they unite at the median line to form the linea alba. The fibres of the lower part of this muscle are nearly transverse, and are attached to the upper part of the pubis, between the spine and the angle of this bone, behind the inner pillar of the inguinal ring. In general, the spermatic cord passes beneath the inferior edge of the internal oblique, which is parallel to the crural arch, and united to that of the transverse muscle. It is at this spot the *cremaster* arises; its fleshy fibres surround the cord and testicle in the form of a noose, and appear to have been separated from the internal oblique during the passage of the testicle.

§ 185. The *transversalis muscle*, situated beneath the internal oblique, is attached to the six last ribs or their cartilages, to an aponeurosis which terminates on the vertebral column, at the three anterior fourths of the crista ilii, and lastly at the two outer thirds of Poupart's ligament. From these different points of attachment, its fleshy fibres proceed horizontally forwards, and end in an aponeurosis, which unites to it that of the internal oblique, passes behind the rectus muscle throughout the whole of its upper three fourths, and in front of this muscle at its lower part, to terminate, lastly, on the median line. The inferior edge of the transversalis muscle is generally joined to that of the internal oblique, and passes with it above and in front of the spermatic cord.

§ 186. The *rectus abdominis*, extending vertically on each side of the linea alba, is inclosed in a kind of fibrous sheath, formed by the aponeurosis of the muscle of which we have been speaking. It is attached superiorly to the ensiform cartilage, and to the edge of the cartilages of the fifth and sixth ribs, and terminates inferiorly in a flattened tendon, which is inserted into the pubis behind the pyramidalis muscle and the internal pillars of the abdominal ring. The fleshy fibres of this muscle run parallel to each other, and are intersected in three or four different spots by tendinous lines, *(lineæ transversæ.)* The anterior surface is covered superiorly by the aponeurosis of the pectoralis major, and in the rest of its extent by that of the external and internal oblique,

excepting at its lowest point, where the *pyramidalis* is generally found. This name is given to a small bundle of fleshy fibres, placed on the median line of the body; it arises from the superior part of the pubis, behind the internal pillars of the ring, and in front of the tendon of the rectus muscle, from which it is separated by the aponeurosis of the transverse muscle. Inferiorly, it is terminated by a thin, long tendon, which is lost on the linea alba. The posterior surface of the rectus is connected inferiorly with the peritoneum, at its upper extremity with the costal cartilages, and in the rest of its extent with the fibrous layer which forms the posterior portion of its aponeurotic sheath. The cellular tissue which unites these parts is so loose, that, in certain kinds of hernia, the space which is situated between the posterior surfaces of this muscle and the fibrous sheath, may be mistaken for the abdomen, and the intestines may be pushed into it, under the supposition that they are reduced into the abdominal cavity. This mistake, of which Colles relates a case, may be followed with the most serious consequences; for if the surgeon unites the edges of the wound without perceiving his mistake, the intestines would remain inclosed between these parts, and a fatal result would probably be the consequence.

§ 187. The *linea alba* is formed by the interlacement of the aponeurotic fibres of the three large muscles of the abdomen on the median line of the body, and consists of a very firm and yielding band, extending from the ensiform cartilage of the sternum to the symphysis pubis. Its superior half is larger and less solid than the inferior; in pregnant women, it contributes considerably to the development of the uterus. If this part be carefully examined, by placing it between the eye and the light, we shall find that in women who have had many children it is of a very variable thickness, thin and transparent in some parts, while in others it is much thicker. Herniæ, and fatty tumours which may be mistaken for herniæ, occur in the linea alba.

§ 188. In the centre of the linea alba, the *umbilicus* is situated, the appearance of which is very different from what it presents before birth, when it gives pas-

sage to the umbilical vessels and urachus. Before the eighth week of uterine life, the umbilical cord has the form of a funnel-shaped tube, which is immediately continuous with the abdomen; its size is very considerable. Lastly, the muscles which form the abdominal parietes have the appearance of a yellowish mucus. Towards the twelfth week, the intestines enter completely into the abdomen, the cord loses its infundibuliform shape, and the skin commences to be distinct. At the fourth month, the fibrous structure of the lower half of the linea alba becomes apparent, but the portion situated between the umbilicus and sternum is still quite mucous, and scarcely to be distinguished from the surrounding parts. Up to the seventh month, the umbilicus is still the weakest part of the abdominal parietes; simple pressure with the finger from behind forwards is quite sufficient to force the peritoneum into the interior of the cord, through this opening. At the time of birth, the integuments of the abdomen are continued on the umbilical cord, to the extent of about an inch, but they are merely connected by very losse cellular tissue to the vessels which constitute it. A delicate membranous septum, situated between the umbilical vein and the other vessels of the cord, appears to divide the ring into two nearly equal portions. The vein, which is of a considerable size, is placed above the other vessels, and is not so closely connected to the edges of the umbilical ring as the arteries and the urachus. After birth, all the portion of the cord which is situated beyond the point where the integuments terminate, separates; the skin cicatrizes, and contracts adhesions with the umbilical vessels, which become obliterated. By the obliteration of these vessels, the skin is drawn in towards the abdomen; this produces a depression in the cicatrix, and the vessels themselves are converted into ligamentous cords, which become united into one. Lastly, the kind of tubercle which is thus formed in the umbilical opening, forms very strong adhesions with the peritoneum and the edges of the ring. This spot becomes the strongest part of the abdomen.

From the preceding account, it is evident that con-

genital umbilical hernia is not an uncommon occurrence. During the fœtal life, several circumstances may produce the formation of these tumours; they may depend on an original defect, similar to that which constitutes spina bifida, hare-lip, &c. In fact, if the abdominal muscles are but imperfectly developed, and do not unite on the median line in all their extent, the intestines, instead of remaining completely in the abdominal cavity, may enter in part into the interior of the umbilical cord, and form a hernial tumour. The looseness of the edges of the umbilical cord, even after the complete formation of the linea alba, renders the passage of the viscera through this opening very easy, especially when the liver and the other viscera have acquired a considerable size. In cases of this kind, the tumour is placed between the vein and umbilical arteries, in the substance of the cellular tissue which unites these vessels. During the early months of life, the weakness of the ring, and the continual cries of the child, are circumstances which favour the formation of hernia, if care be not taken to exercise a proper degree of pressure on the umbilicus after the fall of the cord, especially if the distension of the abdomen continues after birth. In adults, umbilical hernia is more common in women than men; but it appears that in ninety-eight cases out of a hundred, the hernia takes place above or below the umbilicus, and not at the umbilicus itself, which is owing to the great resistance of the cicatrix filling the umbilical opening.

§ 189. The outer edge of the lower tendon of the rectus abdominis becomes thin, and is continuous with the portion of the pelvic aponeurosis, which has been called by Sir Astley Cooper, *fascia transversalis*, or by Hesselbach, the internal inguinal ligament. This membrane lines the internal surface of the transversalis muscle, and near to the diaphragm and loins degenerates into cellular tissue. Inferiorly it is continuous with the iliac aponeurosis and the posterior layer of Gimbernat's ligament, which is inserted along the crista of the pubis, and is united to the edge of the internal fold of Poupart's ligament, from the spine of the ilium to the pubis. This union is so intimate, that several anato-

mists have regarded the fascia transversalis merely as a fold of the membrane of which we have been speaking. In fact, this membrane is often composed of two very distinct layers, which are united on a level with the posterior edge of the crural arch: the one is a continuation of the pelvic aponeurosis, which leaves the iliacus muscle to be continued on the anterior parietes of the abdomen: the other arises from the internal and superior edge of Poupart's ligament. From this arrangement, a deep and narrow groove is formed, which extends from the pubis to the anterior superior spine of the ilium, its concavity being turned upwards. The greater part of this sulcus is filled by the lower fibres of the internal oblique and transversalis, which are inserted into it; but anteriorly it lodges a portion of the spermatic cord, or the round ligaments of the uterus. Anteriorly it is formed by the aponeurosis of the external oblique, which presents downwards and forwards the abdominal ring, or anterior opening of the inguinal canal (vide § 182): posteriorly, it is formed by the fascia transversalis, which is also perforated for the passage of the same parts. This opening (the *internal abdominal ring* of some authors, or the *internal opening of the inguinal canal*) is of an oval shape, its greatest diameter being vertical. It is about half an inch long in the male, and much less in the female: it is situated about an inch and a half above, and to the outer side of the external ring. Its internal edge is separated from the symphysis pubis about three inches, and is much thicker than the external: it is strengthened by a falciform fibrous bundle, from the crural arch. Its inferior edge, thin and tendinous, is situated about half an inch from Poupart's ligament; inferiorly it is bounded by the internal oblique, and transversalis muscles. Lastly, it is continued forwards under the form of a membranous sheath, which surrounds the spermatic cord, and is lost in the outer cellular tissue of the tunica vaginalis. This explains why the internal ring ought to be considered rather as the entrance into a funnel-shaped cavity, than a simple foramen.

§ 190. The space comprised between the opening of which we have been speaking, and the external abdo-

minal ring, constitutes the inguinal cavity, which either lodges the spermatic cord, or the round ligament of the uterus. The anterior wall of the *inguinal canal* is then formed by the aponeurosis of the external oblique; the posterior by the fascia transversalis; the superior by the edges of the internal oblique and transversalis, and the inferior by the groove at the upper surface of the crural arch. In children, the two openings of this canal nearly correspond to each other; hence, it is not very long, and appears to form one opening only, which traverses the parietes of the abdomen directly from before backwards. In the adult, the relative state of this part differs; for the length of the inguinal canal is generally from two inches and a half to three inches in length, although the parietes of the abdomen at this part are not more than a quarter of an inch thick. In fact, its two openings, instead of being placed opposite to each other, are separated to the distance of about three inches, and the canal takes an oblique course from above downwards, and from without inwards. This obliquity of the inguinal canal tends very much to diminish the frequency of inguinal herniæ, for during the contraction of the parietes of the abdomen the viscera tend to escape at the points which offer the least resistance, and the part occupied by the inguinal canal is among this number; but its obliquity prevents the viscera being pushed according to the axis of the canal, and consequently diminishes the acting force. Also, the cause which tends to produce the hernia lessens the caliber of the canal by pressing the fascia transversalis against the aponeurosis of the external oblique. In employing the taxis for the reduction of an inguinal hernia, the direction of the canal must be particularly borne in mind, in order that the pressure may be employed in the direction of the axis of the canal, *i. e.* obliquely from below upwards, and within outwards. But the existence of an old, and very large hernia, very materially changes the state of these parts; in fact, the tumour during its increase pushes upwards and forwards the fibrous bands which form the outer pillar of its ring, so that the pillar becomes thicker at the same time that the ring becomes larger,

and that the length and obliquity of the canal are diminished. When scrotal hernia is very large, the inguinal canal, and the neck of the hernial sac, instead of being directed obliquely from the pubes to the groin, merely form one large opening, which opens nearly direct into the abdomen from before backwards.

In women the inguinal canal is much narrower than in men*—hence herniæ form with greater difficulty in the former than the latter. From the result of the London Truss Society, it appeared that, among four thousand and seventy persons affected with rupture, there were only thirty-four females, all the rest being males. Another circumstance equally remarkable, but the cause of which is less evident, is the more frequent occurrence of hernia on the right than on the left side; it appears that the first are to the second in the proportion of fifty-one to thirty-four. This difference is generally attributed to the pressure exercised on the intestines by the liver during the contraction of the diaphragm, to the oblique situation of the mesentery, and to the habit of generally using the right arm.

§ 191. The *spermatic cord* is formed by the spermatic vessels and nerves, the vas deferens, cellular tissue, and the membranous coverings. It is united

* The following are the results of Sir A. Cooper's and M. J. Cloquet's investigation on this subject :—

	Male.		Female.	
	Inches.	Lines.	Inches.	Lines.
Distance from the symphysis pubis—				
1. To the anterior superior spine of the ilium	5	6	6	0
2. To the spine of the pubes	1	2	1	4
3. To the inner part of the abdominal ring	0	10	0	11
4. To the internal parts of the upper opening of the inguinal canal	3	2	3	3
5. To the middle of the external iliac artery	3	2	3	5
6. To the middle of the external iliac vein	2	10	3	1
7. To the origin of the epigastric artery	3	0	3	3
8. To the passage of the epigastric artery, on the inner side of the superior opening of the inguinal canal	3	10	3	0

by loose cellular tissue to the parietes of the inguinal canal, the course of which it exactly follows to the level of the ring; it then changes its direction, to descend almost vertically into the scrotum. The spermatic arteries arise from the aorta in the lumbar region, and descend behind the peritoneum, and in front of the psoas and iliacus muscles, to the superior opening of the inguinal canal; they join the vasa deferentia, and, forming a kind of curve, follow the course of the inguinal canal. The vas deferens, arising from the posterior and inferior part of the epididymis, takes a serpentine course towards the ring, and is lodged behind, and to the inner side of the spermatic vessels, in the substance of the cord. When it reaches beyond the anterior opening of the inguinal canal, the vas deferens leaves the spermatic vessels, and dips down into the pelvis.

In young persons, there is a membranous prolongation, which establishes a communication between the peritoneal cavity and that of the tunica vaginalis: this tunic or covering is merely a portion of the peritoneum, drawn down to the bottom of the scrotum during the descent of the testicle. In the progress of age, this communication is completely obliterated, and sometimes no trace whatever of it is left. This state of the tunica vaginalis, during the fœtal life, and for some time after birth, produces very great differences between inguinal herniæ, which form at this time of life, and those which occur in the adult. In fact, the hernial sac is nothing more than the tunica vaginalis, instead of a fold of the peritoneum. The neck of the tunica vaginalis always corresponds to the point where the spermatic cord passes beneath the edge of the transversalis muscle; consequently, in this kind of hernia, which is called congenital, but which may take place some time after birth, the epigastric artery is always situated on the internal side of the neck of the tumour.

The cellular tissue, which connects the different constituent parts of the spermatic cord, is continuous with that placed between the peritoneum and the parietes of the abdomen. In the substance of this tissue

the deposition of serum takes place which constitutes hydrocele, by infiltration of the spermatic cord. A cellulo-aponeurotic layer, of which we have already had occasion to speak, is continuous with the edge of the superior opening of the inguinal canal, and forms the common investment of the cord; when it reaches the upper edge of the testicle, it is lost in the cellular tissue of the tunica vaginalis. In cases of extra-vaginal hernia, the tumour, although it descends into the scrotum, cannot proceed beyond the point where the spermatic vessels enter into this organ. In congenital hernia, on the contrary, the protruded viscera, being contained in the same membranous parts which lodge the testicle, may descend lower than this organ, although it may take its place, and push it upwards and backwards. The cremaster muscle surrounds this sheath, and in its turn is inclosed in a very fine cellular expansion, proceeding from the edge of the abdominal ring, and in the prolongation which the superficial fascia sends on the cord. In cases of external inguinal hernia, the viscera push the peritoneum in front of them, and traverse the inguinal canal before the spermatic cord. In the interior of this oblique tube, the peritoneal sac has the form of a cylindrical tube, and constitutes what is called the neck of the hernial sac. It adheres to the spermatic cord by soft and yielding cellular tissue, and enters between the spermatic vessels and the sheath formed by the cremaster and the cellulo-aponeurotic processes coming from the edges of the openings of the inguinal canal. If the hernia be of long standing, and large, the fleshy fibres of this muscle acquire sometimes very considerable firmness and strength, and it sometimes happens that, in certain cases, their contraction is sufficient to produce the return of the hernia. Sometimes the cremaster forms close adhesions with the edges of the inguinal ring, and great difficulty is then experienced in the introduction of a director between its fibres and the edge of the ring. In recent herniæ, on the contrary, the director can be introduced with ease between these parts, as well as between the cremaster and hernial sac. In general, the spermatic cord is situated behind the

hernial sac; but if the tumour acquire a considerable size, the spermatic vessels become separated, and may be even pushed to the sides or anterior parts of the tumour.

§ 192. It is immediately behind the cellulo-aponeurotic layer,* in which the upper opening of the inguinal canal is situated, that we in general find the epigastric vessels; sometimes, however, they are placed between the layers of this fascia, or even in front of them. The epigastric veins, generally two in number, follow the course of the artery, and open into the external iliac vein. The *epigastric artery* commonly arises from the anterior or internal part of the external iliac artery, at the spot where it passes beneath the crural arch. Sometimes this vessel arises from a trunk which is common to it and the obturator, and the spot at which it arises may vary to the extent of one or two inches. In every case, however, when it has reached the posterior surface of Poupart's ligament, it proceeds almost horizontally inwards, passes beneath the external angle of the upper opening of the crural canal towards the edge of the rectus muscle, crossing at the same time the course of the spermatic cord. It is then situated on the inner side of the upper opening of the inguinal canal, about an inch to the outer side of the superior part of the inguinal ring; but in certain cases, it is only a few lines distant. In this part the epigastric artery gives origin to one or two small vessels, which pierce the aponeurosis situated above, and are distributed to the cremaster muscles and the outer sheath of the spermatic cord. After crossing the cord, this vessel furnishes one or two branches, which proceed horizontally inwards, and anastomose with the branches of the same artery on the opposite side, behind the rectus muscle and pubes. Lastly, after reaching the outer edge of this muscle, it proceeds directly upwards, and terminates by sending ramifications into the substance of the anterior wall of the abdomen, which anastomose

* {The fascia transversalis of Sir A. Cooper. Between this and the peritoneum we find the epigastric artery and vein.—W.}

with the lumbar, intercostal, and internal mammary arteries.

In most of the cases of inguinal hernia, the relations of the epigastric artery with the abdominal ring are considerably changed. In consequence of the alterations which the hernia produces in the direction and length of the inguinal canal, this vessel, instead of being situated about ten lines to the outside of the ring, is carried to the inner side of this opening. It is the danger of wounding the epigastric artery, which renders the division of the neck of the hernial sac the most important and difficult part of the operation for strangulated hernia. Different directions have been given for the direction in which the stricture in inguinal hernia is to be divided. It is the situation of the spermatic cord which ought to serve as a guide in this operation. Chopart and Desault recommend the incision to be made outwards when the spermatic cord is situated behind the hernial sac, and to make the incision upwards and inwards, when it is placed to the outer side of the tumour. Whenever the hernia is placed in front of the cord, M. Boyer divides the superior and external angle of the ring. Scarpa divides the stricture parallel to the linea alba. Lastly, if the spermatic cord be situated in front of the sac, the operator must carefully ascertain whether it be placed in front of the inner or outer side of the tumour; for, in the former case, the epigastric artery corresponds to the inner side, and in the latter to the outer side, of the hernia.

We shall presently see that the situation of the epigastric artery regulates the direction to be given to the incision in dividing the stricture in femoral hernia, and it is to avoid wounding this vessel in paracentesis abdominis, that most English surgeons recommend the trocar to be introduced on the median line midway between the umbilicus and pubes; in this spot no part of importance will be divided. But if, on the contrary, this operation be performed in the centre of a line drawn from the linea alba to the anterior superior spinous process of the ilium, the epigastric artery might be easily wounded. In most cases, wounds of the epi-

gastric artery produce fatal consequences, for, from its situation, it is evident that the hæmorrhage will be internal: hence the surgeon is only informed of the mischief by the development of acute peritonitis, and other symptoms of effusions of blood into the abdominal cavity. If, on the contrary, the surgeon is aware, at the time of the accident, that the epigastric artery has been wounded, the operation proposed by Bogros for tying this vessel may in most cases save the life of the patient. According to this plan, the integuments of the abdomen are to be divided immediately above the crural arch, towards the middle of the space comprised between the anterior superior spine of the ilium and the symphysis pubis: the fascia superficialis and the aponeurosis of the external oblique are then to be divided, when the spermatic cord will be seen at the bottom of the wound; and after carrying it upwards, the fascia transversalis and superior opening of the inguinal canal will then be brought to view. The opening is then dilated, and the artery, which is situated behind, may be secured.

§ 193. Immediately behind the recti and transversales muscles, and the transversalis fascia, the *peritoneum* is situated. This membrane is united to the anterior parietes of the abdomen by a layer of cellular tissue. Close to the opening of the internal inguinal ring, the peritoneum and fascia are very closely united. The thickness of this membrane differs very much, according to the individual and the part of the abdomen examined. In the umbilical region, and along the linea alba, it is thinnest. On examining its posterior surface, we observe on each side, in the hypogastric region, two depressions, separated by a large triangular and falciform fold, which sustains the umbilical artery. This vessel arises from the anterior part of the hypogastric artery, proceeds obliquely forwards and inwards, to the superior and lateral part of the bladder, and then takes a course from behind forwards, and below upwards, towards the umbilicus. After the umbilical cord drops off, this vessel is transformed into a kind of ligament. Of the two depressions, to which we before alluded, the inferior and in-

ternal is the smallest, and corresponds in the groin to the spot where the spermatic cord crosses the epigastric artery: internally it is separated from that of the opposite side, by a fold of peritoneum containing the urachus. The superior and external depression is much larger and deeper than the internal: its form is in general triangular, the base being turned backwards, and outwards towards the flank, and the apex inwards, towards the spot where the spermatic cord enters into the inguinal canal. In general, the peritoneum presents in this part a funnel-shaped depression, the depth of which may be increased by drawing the spermatic cord from above downwards. This membranous cul-de-sac, situated on the anterior surface of the cord, is a remains of the canal of communication, which exists in the fœtus and early life between the peritoneal cavity and that of the tunica vaginalis. Inguinal herniæ generally commence in this spot, and traverse the inguinal canal in front of the spermatic cord, and in the interior of the muscular aponeurotic sheath. It sometimes happens that all the viscera make their escape through the transversalis fascia, close to the inguinal ring, and on the inner side of the spot where the epigastric artery crosses the cord. In this kind of hernia, which is called internal,* the epigastric artery is always situated on the outer side of the neck of the hernial sac, and the peritoneum is only covered by the fascia superficialis, the cellular expansion which arises from the edge of the ring, and the integuments. External inguinal herniæ are inclosed in six coverings, which are formed by the skin, superficial fascia, the prolongation from the edge of the ring, the cremaster muscle, the cellulo-aponeurotic layer coming from the edge of the upper opening of the canal, and, lastly, the hernial sac.

* {As in this case the protrusion takes place from the external abdominal ring, without having traversed the abdominal canal, and is produced by a rupture of the tendons of the internal oblique and transversalis muscles and the fascia transversalis, which close the external ring, it is called ventro-inguinal hernia. When we look at the different relations of the epigastric artery, in the two varieties of inguinal hernia, the importance of carefully distinguishing between them will be manifest.—W.}

Sometimes it happens that the parts contained in the hernial sac are compressed to such a degree, as to occasion very serious symptoms, and prevent the reduction of the tumour. The pressure made by the aponeurotic opening is the most frequent cause of this state, which is called stricture. Partial obliteration of the inguinal canal, from a considerable enlargement of the spermatic cord, may also cause stricture, but sometimes the hernial sac itself keeps up the pressure. It appears that the tunica vaginalis is more subject to this kind of contraction, than the sac of common inguinal hernia. Whatever may be the cause of strangulation, recourse must be always had to the operation, since by milder means the reduction cannot be effected, and much valuable time may be lost. The incision of the integuments ought to be made in the centre of the tumour: for if the lateral and inferior parts be divided, the spermatic artery, which is sometimes alone, at others united to the vas deferens, may be wounded. The hernial sac is then opened, and a grooved director is introduced, on which either the ring only, or together with the hernial sac, is to be divided. We have spoken of the direction of the incision at § 192. In girls there is frequently a process of peritoneum, which accompanies the round ligament of the uterus, and which is analogous to the tunica vaginalis: this forms a kind of canal, which terminates in a cul-de-sac. Sometimes the viscera make their way into it, and form a hernial tumour.

§ 194. Poupart's ligament (§ 183.) extends from the anterior superior spinous process of the ilium to the spine of the pubes, and converts into a triangular foramen the large hollow at the superior part of the pelvis. This hollow is slightly inclined downwards, inwards, and forwards; the space which separates its two bony boundaries is greater in females than males; in the latter it is between four and five inches in length. The external portion of this opening, which consists in part of bone and in part of ligament, is occupied by the iliacus and psoas muscles, and by their aponeurotic coverings; its internal angle is closed by Gimbernat's ligament. Lastly, the portion which is situated be-

tween this fibrous prolongation and the linea ilio-pectinea, gives passage to the crural vessels, and constitutes the superior opening of the crural canal.

§ 195. The name of *Gimbernat's ligament* has been given to an aponeurotic expansion, which is attached to the crista of the pubes, and is continuous with the internal portion of the posterior and inferior of Poupart's ligament. Some anatomists only consider it as the reflected portion of the external pillar of the ring; but it is in general formed of two sufficiently distinct layers, although they are very intimately united near to their common insertion into the ilium. The posterior and deep one appears continuous with the fascia transversalis and the tendon of the rectus muscle; the anterior and superior is continuous with the outer pillar of the ring, and forms the third insertion of the aponeurosis of the external oblique (§ 183). The form of this aponeurotic expansion is triangular, and its length is in general from six to ten lines. Lastly, its outer edge, which is thin, unyielding, concave, and falciform, is free, and forms the internal angle of the superior opening of the crural canal.

§ 196. The portion of the pelvic aponeurosis called fascia transversalis, which forms the posterior wall of the inguinal canal, is attached (vide § 189.) to the posterior edge of Poupart's ligament, and is continuous with the fibrous membrane which lines the iliac fossa, whence it has been termed the iliac fascia. From the close union of these two fasciæ, a kind of cul-de-sac is formed, which lines the angle formed by the anterior parietes of the abdomen and the iliacus muscle, and offers an almost insurmountable obstacle to the passage of the viscera beneath this part of the crural arch. A little below Poupart's ligament, there is a whitish line, which commences about half an inch below the spine of the ilium, and is continued to the internal edge of the opening of the crural canal passing above its anterior edge; in this, the circumflex artery of the ilium is lodged. Superiorly and externally, the fascia iliaca is attached to the internal lip of the crista ilii, between the point of insertion of the transversalis and iliacus muscles, and again appears continuous with the

fascia transversalis. Above and behind, it is continued on the spinal column, passes beneath the iliac vessels, and is firmly attached to the upper aperture of the pelvis, becoming afterwards continuous with the pelvic aponeurosis. Inferiorly and anteriorly, this fibrous membrane is fixed to the crista of the pubis. Lastly, between the outer edge of Gimbernat's ligament and the linea ilio-pectinea, it is continued beneath the crural arch, joins the deep layer of the fascia lata, and constitutes the posterior wall of the crural canal. It is on account of this arrangement that some anatomists regard the common iliac fascia as a prolongation of the crural aponeurosis. The posterior surface of the iliac fascia is united to the anterior surface of the iliac and psoas muscles, which it keeps in their natural situation. The anterior surface of this aponeurosis is separated from the peritoneum by a layer of cellular tissue and the crural vessels. In general, a fibrous layer is given off from this fascia, which proceeds in front of these vessels near their exit from the pelvis, and contributes to the formation of the cellulo-aponeurotic sheath which surrounds them.

§ 197. The *crural canal* is not a simple opening, as several anatomists have supposed; in fact, its formation is somewhat similar to that of the inguinal canal, and without an exact knowledge of which, the anatomy of femoral hernia can never be properly understood. The superior opening of this canal is situated above the pubes, about two inches and a half from the symphysis, and is directed downwards and forwards; its form is triangular. The posterior and internal edge of the opening is the shortest, and is formed by the upper edge of the pubes, at the spot where the deep layer of the crural aponeurosis is attached to that bone. The posterior and external is formed by the portion of the fascia iliaca, which is continued downwards with the fascia lata. The internal angle of this opening is formed by the concave edge of Gimbernat's ligament (§ 195); the external by a concave fibrous fold situated between Poupart's ligament and the psoas and iliacus muscles. Lastly, the posterior, which is less marked, corresponds to the linea ilio-pectinea. The anterior wall of

the crural canal is formed by the superficial layer of the fascia lata (§ 183), and covered by the superficial fascia, which strongly adheres to it towards its lower part. The posterior and internal wall is formed by the deep layer of the crural aponeurosis which covers in this spot the pectinalis muscle. The posterior and external, equally narrow, but, at the same time, slightly convex, is formed by the iliacus and psoas muscles, and covered by the expansion of the fascia iliaca. Lastly, the inferior opening of the crural canal directed forwards, is the spot at which the vena saphæna enters. Behind this opening the crural canal appears continuous with the sheath which surrounds the femoral vessels; its length varies, according to the height at which the vena saphæna traverses the crural aponeurosis; it is generally from six to fifteen lines. Its form is triangular, the greatest diameter being superiorly. Its direction is nearly vertical, the axis of its upper opening is directed obliquely downwards and forwards, whilst that of its lower opening is horizontal and turned from behind forwards.

§ 198. The *external iliac artery* arises from the common iliac, on nearly a level with the sacro-iliac articulation, and descends obliquely, externally and anteriorly, from the internal surface of the psoas magnus, towards the superior opening of the crural canal. This vessel rests on the iliac fossa, and very often closely adheres to it; the peritoneum covers it, but only adheres to it by the medium of very loose cellular tissue. Lastly, posteriorly and internally, it is connected with the crural vein. When it reaches the crural canal, the external iliac artery takes the name of femoral, and proceeds from above downwards and from without inwards, in the interior of this canal, to the anterior and posterior wall of which it is connected; internally it corresponds to the crural vein.

The layer of cellular tissue, which is situated between the peritoneum and aponeurotic iliac fascia, and which has received the name of *fascia propria*, from the membranous appearance which it often presents, surrounds the external iliac artery, and forms a sheath for it, which is continued through the crural canal; it re-

ceives from it several aponeurotic bands, which increase its thickness and solidity, at the same time that they afford a support to the artery. Lastly, one of these fibrous bands passes from the anterior wall of the canal to its posterior and external walls, is situated on the inner side of the artery, and separates this vessel from the vein which accompanies it.

The *crural vein*, after having received the vena saphæna (§ 181), ascends towards the pelvis, and takes the same course as the artery, on the inner and posterior side of which it is situated. This vessel, as well as the external iliac artery, is surrounded by a cellulo-aponeurotic sheath; it is in contact with the three parietes of the crural canal, but there remains between it and Gimbernat's ligament, a very large space, filled with cellular tissue and some lymphatic ganglia; it is this which constitutes the inguinal ring of some anatomists. Superiorly, this opening is formed by a kind of septum, which is sometimes thick and resisting, at others weak and only cellular. This membrane, concave superiorly, convex inferiorly, and presenting openings for the passage of lymphatic vessels, appears to be only a continuation of the layer of condensed cellular tissue called *fascia propria*. Sir A. Cooper calls it *fascia cribriformis*, and M. J. Cloquet, *septum crurale*. It is in this spot that the portion of the wall of the abdomen comprised between Poupart's ligament and the circumference of the pelvis, presents less resistance than any other; hence, it is here that crural herniæ generally make their appearance. This affection is frequently found in women who have had several children; it is very rare in young girls; and still less frequent in men. Scarpa attributes this difference to the smallness of the inguinal ring, and to the more hollowed form of the pelvis in the female. Tumours of this kind are covered by skin, subcutaneous cellular tissue, superficial fascia, fascia propria, and the hernial sac, the neck of which is placed under the crural arch; it is very narrow, and about five lines in length. Its anterior side corresponds to Poupart's ligament, and to the falciform process of the crural aponeurosis. Its posterior touches the pubes; its external, the iliac vein; and its internal,

Gimbernat's ligament. In general, the hernial tumour is entirely contained in the crural arch; but, sometimes, it escapes by the inferior orifice of this tube; and passes at first directly forwards, then downwards on the vena saphæna, and upwards on the falciform process of the fascia lata. From the narrowness of the opening by which crural herniæ take place, and the unyielding nature of its edges, it is evident that these tumours are very likely to be strangulated, and that the chance of reducing them by means of the taxis, must be much less than in inguinal hernia. The strangulation may be produced by the sac or by one of the orifices of the crural canal. In general, it is the internal part of the superior or abdominal orifice which produces it; the direction in which the stricture is to be divided, is a very important point, on account of the blood-vessels which surround the neck of the sac. In fact, if the incision be made upwards and outwards, the surgeon runs the risk of wounding the epigastric artery, which generally arises, as we have seen, from the external iliac behind the crural arch, (§ 192), and which ascends towards the median line, describing a slight curve on the outer side of the hernial sac. If, on the contrary, the crural canal be divided directly upwards, or even upwards and forwards, the spermatic cord may be divided in the male, and the round ligament of the uterus in the female. The division of this last part might not give rise to a troublesome hæmorrhage; but that of the spermatic cord might be fatal. The artery and spermatic vein of which we have before spoken (§ 191), are found behind Poupart's ligament, cross the epigastric artery, and pass on the anterior surface of the hernial sac. The vas deferens takes the same course. It is then evident, that it is directly inwards that the stricture must be divided. Richter and Scarpa advise the incision to be made at the internal part of Poupart's ligament, near its insertion into the spine of the pubes. But the surgeon would run the risk of dividing the spermatic cord if the incision were extended beyond a few lines; and, moreover, the cause of the strangulation would not be destroyed, unless, at the same time, Gimbernat's ligament were divided.

Hence, most surgeons prefer Gimbernat's method. According to this method, this ligament is divided as near its attachment to the pubes as possible, by carrying the instrument from without inwards. The size of the crural ring may thus be increased about half an inch, without fear of wounding the spermatic cord, or the epigastric artery, at least when it takes its usual origin. In fact, if this vessel arises from the obturator, it would be situated on the inner side of the hernial sac; and if the obturator arose from the epigastric, it would also pass on the inner side of the neck of the sac. Hence, the incison should not be made larger than is necessary for the reduction of the hernia.

Different plans have been proposed for tying the external.iliac artery. Mr. Abernethy recommends an incision to be made about four inches in length, commencing about an inch and a half from the anterior superior spinous process of the ilium, and terminating half an inch from the crural arch. In this manner the integuments, fascia, and tendon of the external oblique are to be divided, and the finger is to be introduced below the inferior edge of the internal oblique and transversalis muscles, to protect the peritoneum whilst these muscles are divided. The operator then raises the peritoneum with the fore-finger till he reaches the inner edge of the psoas, and distinctly feels the pulsation of the artery, which is still covered by a layer of cellular tissue, the density of which almost equals that of a fibrous membrane. The vein is situated to the inner edge of the artery, and is intimately connected to it. In general, a branch of a nerve accompanies this vessel, and care must be taken not to include it in the ligature. According to Sir Astley Cooper's method, a semilunar incision is to be made through the integuments in the direction of the fibres of the external oblique, extending from near to the anterior superior spinous process of the ilium to a little below the inner side of the inguinal ring. The tendon of the external oblique is divided in this incision, and, on raising the flap, the spermatic cord may be seen passing beneath the edge of the internal oblique and transversalis muscles, and the superior opening of the inguinal canal and the epigastric artery,

proceeding along the inner edge of this opening, beneath which the iliac artery is situated. Lastly, by passing the finger beneath the spermatic cord, the iliac vessel may be felt. Bogros has also recommended a plan in which the skin and superficial fascia are to be divided, as in the operation for tying the epigastric artery: the tendon of the external oblique being raised with a director, and divided according to the direction of the crural arch, the operator carries the vessels of the cord and the cremaster beneath the upper lip of the wound, and dilates the opening made in the transversalis fascia. Then following the direction of the epigastric artery with the fore-finger, the layer of cellular membrane and lymphatic ganglia, situated beneath the crural arch, are to be pushed to one side, when the iliac artery will be exposed.

§ 199. The *circumflex artery of the ilium* is one of the branches furnished by the external iliac, before its passage under the crural arch: it arises, in general, opposite the epigastric, and proceeds directly upwards and outwards to the crista of the ilium, the direction of which it follows. Frequently, this vessel is double, and then one of the trunks proceeds obliquely inwards, to be distributed to the large muscles of the abdomen.

The *crural nerve*, one of the terminating branches of the lumbar plexus, is situated on the outer edge of the psoas and in front of the iliac muscles, and passes out of the pelvis, beneath the crural arch. In this part of its course, it is situated to the outer side of the femoral vessels, and is separated from it by a kind of fibrous septum. We have already had occasion to speak of the *psoas magnus*, and iliacus. The first of these muscles arises from the lateral and inferior part of the vertebral column, proceeds downwards and outwards, and terminates by a strong tendon, which passes beneath the crural arch, to be inserted into the trochanter minor. The *iliacus* muscle is attached superiorly to the fossa and crista of the ilium; inferiorly, its fibres terminate on the outer edge of the tendon of the psoas magnus.

The part of the circumference of the pelvis situated between the two attachments of the crural arch, and

covered by the parts which we have been considering, presents externally a slight excavation, which separates the anterior superior from the anterior inferior spinous process of the ilium. The first of these eminences gives attachment superiorly to the crural arch, externally to the crural aponeurosis, and to the tensor vaginæ femoris, internally to the iliacus muscle, and by its middle part to the sartorius. The second serves for the insertion of the rectus cruris, and is bounded internally by an oblique groove, which extends to the linea ilio-pectinea. Between this last eminence and the spine of the pubes, a smooth triangular surface is situated, bounded anteriorly by a rough line, which gives attachment to the pectineus muscle, and extending from the cotyloid cavity and the obturator foramen to the spine of the ilium; posteriorly it is bounded by the upper aperture of the pelvis, and crista of the pubis. This surface is directed a little downwards and forwards, and is covered entirely by the pectinalis muscle, which is attached to it, and which separates it from the femoral vessels. The crista of the pubis is a rough line, about five or six lines in length, which gives attachment to Gimbernat's ligament, and extends from the spine of the pubis backwards and outwards, to be continuous with the upper aperture of the pelvis. Lastly, the spine of the pubis serves for the insertion of the outer pillar of the inguinal ring, and pyramidalis muscle. On its inner side there is situated a rough edge, about an inch in length, which terminates at right angles with the symphysis pubis, and it is in contact with the spermatic cord, or the round ligament of the uterus.

§ 200. The peritoneum, as well as all other serous membranes, is a closed sac, and folded on itself, so as to furnish a double investment to the organs which it covers, and to be in contact with itself internally. The external portion of the peritoneum is united to the internal surface of the large muscles of the abdomen (§ 193.), and also lines the other parietes of this cavity. The internal portion of this membrane, that which is folded on itself, surrounds the greater part of the abdominal viscera, and bears different names, according to the part which it envelopes, and the spot where

it joins the wall of the abdomen. One of these folds is called *greater omentum*, or *gastro-colic epiploon*, which is formed by two folds, each composed of two very thin peritoneal layers, united by cellular tissue, and containing blood-vessels and fat. The anterior fold is the continuation of the peritoneal layers which cover the two surfaces of the stomach, and which are united on the anterior edge of this viscus; inferiorly, it folds on itself, so as to form a free and floating border, and then constitutes the posterior fold, the two layers of which separate superiorly, to surround the transverse arch of the colon, and to be continuous with the mesocolon. The kind of apron thus formed by the epiploon covers the convolutions of the small intestines, and is connected with the anterior wall of the abdomen. It extends to the inferior part of the umbilical region, or even into the lesser pelvis. In the fœtus, the great omentum is very short; it does not extend so far in females who have had many children as in others; lastly, it descends lower down on the left than on the right side. From the anatomical relations which we have just mentioned, it is evident that hernia of the umbilicus or linea alba would almost always be formed by the omentum alone, or a portion of intestine surrounded by it. The omentum very often escapes by the inguinal ring, especially on the left side. Artaud affirms that, in twenty epiploic inguinal herniæ, only one occurred on the right side. Crural hernia is also generally formed by the omentum alone, or a portion of intestine.

§ 201. After having raised the anterior wall of the abdomen, we see above the omentum a portion of the greater curvature of the *stomach*. This viscus, the size of which varies very much in different individuals, and under different circumstances, occupies the greater part of the epigastrium, and a portion of the left hypochondrium. The cardia, or œsophageal opening of the stomach, is situated below the diaphragm. The pylorus, or intestinal orifice, placed in the epigastrium more inferiorly and anteriorly than the cardiac, corresponds superiorly and anteriorly to the liver; downwards and backwards to the pancreas, directly back-

wards to the right gastro-epiploic artery, and on the right to the neck of the gall-bladder. The anterior surface of the stomach is in contact with the left lobe of the liver, the diaphragm and false ribs, and, when in a state of repletion, with the anterior wall of the abdomen to a greater or less extent. Inferiorly, it corresponds to the transverse mesocolon, and often to the colon and duodenum. The great curvature, or anterior border, is convex, and surrounded by anastomotic arches formed by the right and left gastro-epiploic arteries; on the right side it forms a kind of curve, which is called the lesser curvature of the stomach, and on the left it presents a very large projection, which is called the greater curvature. Lastly, the small curve of the stomach, concave, directed upwards and backwards, extends from the cardia to the pylorus, and corresponds to the aorta, and lobe of the liver. The small hernial tumours which are sometimes formed in the epigastrium, especially on the left side, are attributed by most authors to the escape of a portion of the parietes of the stomach, through the linea alba. When the cardia becomes the seat of a scirrhous affection, it is impossible to recognise the existence of the tumour on striking the abdomen. But, as the pylorus is situated neither so high nor so deep, percussion may be used with advantage in investigating diseases of this part.

§ 202. The *liver* occupies the right hypochondrium and part of the epigastrium; superiorly, it is convex, and turned directly upwards; through a great part of its extent, it is contiguous to the diaphragm, and is divided into two portions or lobes by a triangular fold of the peritoneum, directed from before backwards, and called the suspensory ligament of the liver. The inferior surface of the liver is irregularly concave, and directed a little backwards. In proceeding from left to right, we observe—first, a superficial depression belonging to the left lobe, and in contact with the superior surface of the stomach; 2d, the fissure of the umbilical vein, situated between the two lobes of the liver, and directed from before backwards; 3d, the sulcus for the vena-porta, a fissure neither so long nor so deep

as the former, which it intersects at right angles; and which lodges the sinus of the vena-porta, hepatic artery, and the roots of the hepatic duct; 4th, the sulcus for the inferior vena-cava, situated near the convex border of the liver; 5th, the lobule (lobulus Sipigelii), a pyramidal eminence, placed behind the fissure for the umbilical vein, and in contact with the vertebral column, between the inferior vena-cava and œsophagus; 6th, the anterior portal eminence, which is not so large as the former, and situated between the fissure for the umbilical vein and a superficial fossa, which lodges the gall-bladder; 7th, lastly, two superficial depressions, corresponding, the one to the right extremity of the transverse arch of the colon, the other to the kidney and supra-renal capsule of the same side. The circumference of the liver is irregularly quadrilateral. Anteriorly, it is thin, convex, and presenting two depressions; one, straight and deep, is formed by the anterior extremity of the sulcus for the umbilical vein; the other, situated on the right side, corresponds to the fundus of the gall-bladder. Its central part is horizontal; to the right and left it is inclined downwards. The posterior edge of the liver, which is neither so long nor so thick as the internal, is rounded, and attached to the diaphragm by dense and serrated cellular tissue, and by two folds of the peritoneum called suspensory ligaments of the liver; it is only in this part that this viscus is not surrounded by the peritoneum, which is reflected superiorly on the diaphragm.

The relations which exist between the liver and surrounding parts, are sufficient to explain the different passages by which the pus makes its escape externally in abscesses of the liver. In fact, if the matter be seated near the convex surface of the liver, adhesions may form between the parietes of the abscess and the diaphragm, and between this muscle and the lungs. Hence, by the process of ulceration, the pus may proceed into the cavity of the thorax, or even pass into the bronchi. If the abscess is situated near the anterior edge of the convex surface of the liver, adhesions may form between this part and the abdominal muscles, and the col-

lection of matter may open externally into the right hypochondriac region or even into the epigastric. Lastly, abscesses situated near the concave surface of the right lobe often empty themselves into the colon, and those placed near the inferior surface of the left lobe sometimes also open into the stomach.

§ 203. The *gall-bladder*, a membranous reservoir, directed obliquely forwards, to the right side and downwards, adheres, by its superior and posterior parts, to the liver: the fundus of this bladder, which is rounded, and covered by the peritoneum, proceeds in general beyond the circumference of the liver, and corresponds to the part of the anterior wall of the abdomen, formed by the outer edge of the rectus muscle of the right side. Inferiorly it rests on the pylorus, the origin of the duodenum, and right extremity of the arch of the colon. It is in consequence of these connexions that, in some cases, biliary concretions of a great size have passed into the intestinal canal, after having excited an inflammation, which has caused the adhesion of the gall-bladder and colon, and then ulceration of their parietes.

§ 204. The spleen, a viscus of rather a large size, and of a soft and spongy tissue, occupies the deepest part of the left hypochondrium, on a level with the ninth, tenth, and eleventh ribs of this side. Externally it is convex, and corresponds to the diaphragm; internally it is divided into two portions by a longitudinal fissure. Posteriorly it rests on the vertebral column, anteriorly on the greater curvature of the stomach. Its circumference, thicker superiorly and posteriorly than inferiorly and anteriorly, corresponds to the aponeurosis of the diaphragm, the left kidney, and its capsule, and to the pancreas.

§ 205. The superior part of the intestinal canal, which immediately follows the stomach, and which is called the *duodenum*, is concealed by the transverse mesocolon and stomach. The duodenum proceeds at first horizontally, then vertically, and lastly transversely from right to left, in front of the vertebral column, and is continued under the name of jejunum. It is in contact, superiorly, with the liver and neck of the gall-bladder; inferiorly, with the inferior layer of the trans-

verse mesocolon; anteriorly, with the stomach, the right extremity of the arch of the colon, and superficial layer of the fold of the peritoneum, of which we have just spoken. Posteriorly, it rests on the vertebral column, the right kidney, the inferior vena-cava, the aorta, and right pillar of the diaphragm; internally, it surrounds the pancreas and superior mesenteric vessels; externally, it is situated between the kidney and right lumbar colon. The deep situation of this portion of the intestine and the manner in which it is attached to the posterior wall of the abdomen, account for its never entering into the formation of hernial tumours.

§ 206. The *pancreas*, situated, as we have before said, at the posterior part of the epigastric region, is a gland of a whitish-grey tissue, of an irregular form, elongated transversely, and flattened from before to behind. Its anterior surface is covered by the superficial layer of the transverse mesocolon, the stomach, and first horizontal portion of the duodenum. Its posterior surface presents a sulcus, which lodges the splenic vessels, and corresponds to the plexus of nerves and lymphatics, to the superior mesenteric vessel, to the vena-cava and aorta. Lastly, its superior border is traversed by the cœliac artery. Hence, when this viscus becomes the seat of a scirrhous tumour, it may compress these vessels, and cause a considerable impediment in the circulation. The arteries may also, in these cases, communicate pulsatory motions to the morbid mass, and the complaint may be mistaken for aneurism.

§ 207. The *small intestines*, properly called, or the *jejunum and ileum*, follow the duodenum, and terminate in the cœcum, which is situated in the right iliac fossa. This portion of the alimentary canal is very long, and forms numerous convolutions, which occupy the umbilical and hypogastric regions, and a part of the lumbar and iliac fossæ and the pelvis. Anteriorly, it is convex, and floating, and in contact with the greater omentum and anterior wall of the abdomen. The posterior surface of the convolutions of the short intestines is concave, and inclosed by the peritoneum. This membrane, arrived in front of the vertebral column, is reflected from behind forwards, and forms a fold,

which lodges the intestines, the superior mesenteric vessels, and a great number of lymphatic ganglia. Lastly, it is this portion of the intestine which most generally forms inguinal, femoral, vaginal, and perineal herniæ.

The *cæcum* is a very large dilatation of the digestive tube, situated in the right iliac fossa, between the ileum and colon; it is in contact with the parietes of the abdomen anteriorly, with the psoas and iliacus muscles posteriorly, and with the small intestines internally, inferiorly, and to the left side; and anteriorly it presents the appendix cæci vermiformis, which is about two or three inches long; lastly, on the left it communicates with the colon by an opening, furnished with a valve. The cœcum and its appendix sometimes escape by the inguinal canal, or by the crural canal of the right side; but this part of the intestine is much less subject to displacement than the small intestines and the colon.

The commencement of the large intestines, or *right lumbar colon*, proceeds from the cœcum superiorly and a little posteriorly, to very near the edge of the false ribs; it is covered by the peritoneum and short intestines. Internally, it is attached to the transverse mesocolon and to the mesentery; externally, it rests on the wall of the abdomen, and posteriorly, it is united to the quadratus lumborum, and to the kidney of the right side by fatty cellular tissue, or by a fold of the peritoneum. The colon then proceeds directly from the right to the left hypochondriac regions, by passing behind the greater omentum, below the stomach, above the small intestines, and in front of the transverse mesocolon. This portion of the large intestines is called the arch of the colon, and is in contact with the liver, the greater curvature of the stomach, and the spleen, by its superior surface. Anteriorly, it gives attachment to the omentum, and is in contact with the anterior wall of the abdomen; posteriorly, it is concave, and attached to the posterior wall of the abdomen by the transverse mesocolon, which then becomes continuous with the mesentery, situated beneath it. From the left side of the abdomen the colon presents

an arrangement nearly similar to that of the right lumbar colon, and descends even into the left iliac fossa, where it describes a double curve, and is continuous with the rectum, towards the superior entrance of the pelvis; this portion of intestine is called the sigmoid flexure of the colon, on account of its form, occupies the posterior part of the iliac fossa, and is attached to it by a very extensive and loose fold of peritoneum, directed from left to right, and called iliac mesocolon.

This arch of the colon is very frequently found in umbilical herniæ, and sometimes in those of the inguinal and crural canals; it may also escape through an opening of the diaphragm, and penetrate into the cavity of the chest. The iliac portion of this intestine escapes, in general, by the inguinal and crural canals of the left side; but it must be attached to the left iliac fossa in a very loose manner, to enter into the formation of herniæ on the opposite side.

Behind the peritoneum, and the different organs situated in the folds of this membrane, are placed the aorta, inferior vena-cava, the kidneys and their appendages; but, as these organs are joined to the posterior part of the abdomen, we will defer their description to the following chapter.

CHAPTER XIII.

LUMBAR, OR POSTERIOR REGION OF THE ABDOMEN.

§ 208. The lumbar region comprises the parts situated between the median line of the body posteriorly, the external border of the anterior region of the abdomen externally, the posterior region of the chest superiorly, and the superior edge of the pelvis inferiorly. This portion of the trunk is slightly concave from above downwards, and laterally convex. A groove is observed in this spot, at the bottom of which the spinous processes of the lumbar vertebræ are situated,

and which is bounded laterally by a large vertical projection, formed by the muscles of the back.

The integuments throughout this region are very thick; towards the median line, they are closely connected to the supra-spinous ligament by a layer of firm cellular tissue. Towards the flanks, the subcutaneous cellular tissue becomes much looser, and incloses a larger quantity of fat. This arrangement gives a remarkable character to the subcutaneous abscesses of this region; in fact, the pus makes its way externally towards the sides of the abdomen, instead of collecting near the median line; and when depositions of matter form on each side of the central line, they do not communicate together, but are separated by the portion of condensed cellular tissue, which unites the skin to the supra-spinous ligament.

§ 209. Beneath the integuments and cellular tissue which joins them to the subjacent parts, is situated on the median line the *supra spinous dorso-lumbar ligament*, which extends from the central part of the sacrum to the seventh cervical vertebra (§ 162.); but it is no where so large and yielding as in the loins. Its fibres are longitudinal, and are inserted into the apex of the spinous processes, and into the inter-spinous ligaments; its edges are continuous with the aponeurosis of the neighbouring muscles, and more particularly with that of the *latissimus dorsi*. This muscle, of which we have already spoken (§ 124., § 137.), is inserted into the whole length of a very strong and thick aponeurosis, composed of fibres, which cross each other in every direction; it is very large inferiorly, and narrow superiorly; it arises from the posterior surface of the sacrum, from the posterior half of the crista ilii, and from the spinous processes of the lumbar, and even dorsal vertebræ; lastly, superiorly and posteriorly it is partly continuous with the aponeurosis of the *serratus posticus inferior*, which is situated beneath, and which is attached to the three or four first spinous processes of the lumbar vertebræ, to the two or three last dorsal, and also to the corresponding inter-spinous ligaments. The fleshy fibres which arise from this last aponeurosis proceed obliquely outwards, and soon

divide into three distinct bundles, which are attached to the inferior edges of the four first false ribs. The posterior surface of the serratus posticus inferior is connected to the three last ribs, the corresponding external intercostal muscles, and posterior layer of the aponeurosis of the transversalis muscle. This last fibrous membrane, which follows the insertion of the posterior edge of the internal oblique, is large and thin, and is continuous posteriorly with the aponeurosis of the latissimus dorsi and serratus posterior inferior, and is attached to the last spinous processes of the lumbar vertebræ, to the sacrum, and posterior part of the crista ilii.

§ 210. Beneath the aponeurotic layers of which we have just spoken, is the fleshy bundle formed by the union of the longissimus dorsi, sacro-lumbalis, and semi-spinalis dorsi. Inferiorly, it principally arises from the anterior surface of a firm aponeurosis, which presents a great number of openings for the passage of vessels and nerves, and which is attached to the crista ilii, to the sacrum, and spinous processes of the lumbar and dorsal vertebræ. The fleshy fibres are strong and thick, and inserted into the posterior surface of the sacrum and processes of the three or four last lumbar vertebræ. Lastly, when on a level with the last rib, they divide into two distinct portions, and thus form the sacro-lumbalis and longissimus dorsi muscles. The anterior surface of these muscles is connected to the transverse processes of the lumbar vertebræ and middle aponeurosis of the transverse muscle of the abdomen. The internal is contiguous to the semi-spinales dorsi. The posterior branches of the lumbar nerves, after their passage from the foramina intervertebralia, proceed posteriorly between the transverse processes, pierce the muscles of which we have spoken, and terminate on the united aponeuroses of the longissimus dorsi, transversalis, &c., and traverse them, in order to be distributed to the integuments, without presenting any thing worthy of attention. This is also the case with the dorsal branches of the lumbar arteries.

§ 211. The middle layer of the posterior aponeuro-

sis of the transverse muscle of the abdomen, thicker than the external, passes between the sacro-spinalis and quadratus lumborum, to be attached to the base of the transverse processes of the lumbar vertebræ. The *quadratus lumborum*, a fleshy bundle, thick, and quadrilateral, situated on the sides of the vertebral column, is attached to the posterior part of the crista ilii, and to the ilio-lumbar ligament on one side, and on the other to the last rib, and to the base of the transverse processes of the four first lumbar vertebræ. The anterior surface of this muscle is connected to the diaphragm, the psoas, and anterior layer of the aponeurosis of the transversalis muscle, which is attached, as well as the middle layer, to the base of the transverse processes.

§ 212. The *lumbar portion of the vertebral column* is formed by five vertebræ remarkable for their size. The spinous processes of these bones are very large, flattened, horizontal, and quadrilateral; they are not forked, and do not rest close to one another, a space being left between each. They are more subject to fractures than those of the dorsal or cervical, and the motions of flexion backwards are much more extensive in this than in the dorsal region. The arches of the lumbar vertebræ are very thick, large, and not so long as in the other regions. The transverse processes are horizontal, long, and thin. The superior articulating surfaces, very thick, elongated, oval, and concave, are perpendicular, and directed inwards. The inferior equally thick and perpendicular, but, on the contrary, convex, and turned outwards. Lastly, these bodies are thicker anteriorly than posteriorly. From this arrangement, it is evident that the vertebral column describes a curve, the convexity of which is turned forwards. This curve diminishes very much in the horizontal position, and almost completely disappears in old men, the muscles of whose lumbar region are greatly weakened or even paralysed. The ligaments which unite the vertebræ to each other do not present any thing remarkable, except those which fill the interlaminary spaces, and which are called ligamenta subflava. In fact, these ligaments, very elastic and yielding, are

thicker and longer in the groin than in any other part of the vertebral column, and this arrangement, as well as the other circumstances which we have mentioned, powerfully contribute to favour the motion of the lower portion of this bony column, without its strength being less than in the back. But in order that these motions should not be accompanied by pressure of the spinal marrow, it is necessary that the caliber of this bony tube should be greater in the groin than in the back; the foramen in the lumbar vertebræ is large and triangular.

It is in this part of the vertebral column that deep caries of the body of the vertebræ is frequently observed, which cause that kind of deformity known by the name of Pott's disease, and the superficial caries of these bones, which are followed by the formation of abscesses by congestion. In cases of this kind, the pus is situated between the anterior layer of the aponeurosis of the transverse muscle and the peritoneum, and descends in front of the psoas muscle towards the crural arch, beneath which it passes by separating from the layer of cellular tissue, which surrounds the external iliac artery.

§ 213. The *psoas muscle*, of which we have spoken in the preceding chapter, is situated on the lateral and inferior parts of the vertebral column and in the iliac fossa. It arises from the last rib, from the body of the last dorsal vertebra and from the four first lumbar, and from the base of the corresponding transverse processes. It is between this last insertion and the first that the nerves which contribute to form the lumbo-abdominal plexus pass.

The *diaphragm*, of which we have also before spoken (§ 121), is attached to the anterior surface of the four first lumbar vertebræ by the extremities of two kinds of fleshy columns called pillars of the diaphragm; the right pillar is larger and longer than that of the opposite side; they leave between them a very large space, interlace and separate from each other to terminate in the central aponeurosis. The inferior aperture, thus formed, is oblong, and gives passage to the aorta, vena azygos, and thoracic duct. The superior opening,

placed a little to the left of the median line, is about an inch and a half long, and allows the passage of the œsophagus and pneumo-gastric nerves. The median aponeurosis, of which we have before spoken, presents a depression posteriorly. and is trilobed anteriorly. Immediately in front of the insertion of the pillar, the right lateral portion of this aponeurosis presents a square opening, through which the vena-cava inferior passes. Lastly, from the circumference of this fibrous centre proceed fleshy fibres, which are attached to the ensiform cartilage, to the surfaces of the ribs from the seventh to the eleventh and twelfth. The inferior surface of this large muscle, concave and turned forwards, is connected to the kidneys, supra-renal capsules, pancreas, and duodenum posteriorly; the liver on the right, the spleen and stomach on the left side. In the remainder of its extent, it is lined by peritoneum.

The diaphragm is sometimes wholly or partly wanting, and then a portion of the abdominal viscera passes into the cavity of the chest. Hernial tumours of this kind are also sometimes formed at the opening which gives passage to the œsophagus, or an accidental opening. It is, in general, the stomach, the colon, the epiploon, the spleen, or the left lobe of the liver, which thus escape from the abdomen; and these viscera push the peritoneum before them, which is then situated in contact with the pleura, at least whenever the hernia is not caused by a wound of the diaphragm, for then the peritoneum is also divided.

§ 214. The *aorta*, after having traversed the inferior opening left between the pillars of the diaphragm, descends in front of the body of the lumbar vertebræ, to the left of the inferior vena-cava, and behind the peritoneum, stomach, and small intestine. Immediately beneath the diaphragm, this vessel gives origin to the inferior diaphragmatic arteries, which are distributed to the diaphragm and to the neighbouring parts. The cœliac artery is given off from the aorta, very near the articulation of the last dorsal with the first lumbar vertebra, proceeds horizontally forwards and to the right side, between the small lobe of the liver, the pancreas, the cardia, and pylorus, and, after a short course, it di-

vides into three branches, viz. 1. coronaria ventriculi, which follows the small curvature of the stomach; 2. the hepatic, which furnishes the gastro-epiploica dextra, and passes into the substance of the liver; 3. the splenic, which gives origin to the gastro-epiploica sinistra, to the vasa brevia, and is distributed to the spleen. The supra-renal arteries, of rather a small size, arise from the lateral parts of the aorta or from the cœliac, pass outwards on the sides of the vertebral column, and are distributed to the substance of the supra-renal capsules. The superior mesenteric artery arises from the anterior part of the aorta, a little below the cœliac. It is situated between the two folds of the mesentery, and describes a curve, the convexity of which, turned forwards, and to the left side, gives origin to the three right colic arteries, which anastomose with each other, by forming arches on the posterior surfaces of the small intestines. The renal arteries are given off from the sides of the aorta below the supra-renal, and superior mesenteric; they are, in general, two in number, one on each side, surrounded by a great quantity of fatty cellular tissue, and proceed directly outwards to reach the fissure of the kidneys. That of the left side is covered, during this short course, by the renal vein and peritoneum; the right, not so long, is only covered by the vena-cava inferior. The spermatic arteries sometimes arise from the vessels of which we have just spoken; but, in general, they proceed from the aorta. They are very long, thin, and descend almost vertically on the sides of the vertebral column in front of the psoas muscles, and behind the peritoneum, to reach, in man, the inguinal ring, in women, the pelvis and ovary. The inferior mesenteric artery arises about an inch and a half from the termination of the aorta, and descends, at first, to the left, then bends to the right side to pass between the two layers of the iliac mesocolon. It then describes a curve, the convexity of which is turned to the left, is prolonged into the pelvis, and gives origin to the left colic arteries, which are distributed to the portion of the large intestine situated on the left side, in the same manner as the right colics are distributed to the portion of the colon situated

on the right. Lastly, from the posterior and lateral parts of the aorta, the lumbar arteries arise, which are, in general, four on each side; these vessels, of a larger caliber than the intercostal, proceed transversely outwards, behind the pillars of the diaphragm and psoas muscles, to the base of the transverse processes, where they divide into two branches, the posterior of which proceed in a manner we have already pointed out; and the anterior are distributed to the large muscles of the abdomen, and frequently anastomose with each other and the intercostal arteries, the epigastric, tegumentary, &c. It was chiefly by means of these vascular communications that the circulation was carried on in the lower part of the trunk and inferior extremities in the individual on whom Sir A. Cooper tied the aorta. In this difficult operation, this illustrious surgeon made an incision three inches along the linea alba, opened the peritoneum,* passed his finger below the intestines to the vertebral column, and having raised with his nail the layer of peritoneum which covered the artery, passed his finger from left to right, between this vessel and the vertebral column, and then tied it about three inches above its bifurcation.

Among the arteries of which we have just spoken, the aorta and cœliac are most frequently subject to aneurisms. These tumours are, in general, situated in front of the vertebral column, are developed more anteriorly than posteriorly, and terminate by opening into the stomach, the intestines or bladder, either in the peritoneal sac or behind this membrane in the substance of the sub-peritoneal cellular tissue.

When on a level with the body of the fourth lumbar vertebra, the aorta gives origin to the sacra-media; then bifurcates, to form the common iliac arteries. These vessels separate from each other, and pass down-

* {By making an incision about three inches in length, above the anterior spine of the ilium, on the left side, through the abdominal muscles and fascia transversalis, we are enabled to arrive readily at the aorta, on turning aside the peritoneum. By this means we avoid cutting this membrane, but it is questionable if more injury would not result from detaching it so extensively from its connexions, than by making an incision into it.—W.}

wards and a little forwards, to the sacro-iliac articulation, where they bifurcate, to give origin to the hypogastric and external iliac arteries. (§ 198.)

§ 215. The *inferior vena-cava*, situated to the right of the aorta, ascends on the lateral part of the bodies of the lumbar vertebræ to the under surface of the liver; during this course it is covered by the right common iliac artery, the peritoneum, and duodenum. It is placed then in the fissure situated between the right and left lobes of the liver, and passes into the opening in the diaphragm, through which it penetrates into the chest. The thoracic duct, situated to the right of the aorta and to the left of the vena azygos and the sympathetic nerve, which is found on the lateral parts of the vertebral column, present nothing remarkable in a surgical point of view.

§ 216. The *kidneys*, situated on the lateral parts of the spinal column, on a level with the two last dorsal and two first lumbar vertebræ, are glands of an ovoid shape, and of a large size. Their posterior surface, almost plane, is separated from the diaphragm and aponeurosis of the transverse muscle, by a thick layer of fatty cellular tissue. The anterior is convex, and connected, either to the peritoneum only, or to a vertical portion of the duodenum, the liver, and ascending arch of the colon on the right, and with the spleen and descending arch of the colon on the left side. The superior extremity of the kidneys is surrounded by the *supra-renal capsules*, the use of which is not known. The internal edge of this viscus presents a deep fissure, which is partly occupied by the pelvis, a small membranous bag, into which the calices or excretory ducts of this gland open, and the ureter, a long and narrow membranous canal, which descends obliquely inwards to the fundus of the bladder. During this course, it is connected to the psoas muscle, the common iliac, and hypogastric arteries posteriorly, and is covered by the peritoneum and spermatic artery.

It sometimes happens that pus, formed in the substance of the kidneys, makes its way to the surface, and forms a projecting tumour in the lumbar region. But these tumours must not be confounded with ab-

scesses by congestion, which may also pass in this direction, instead of descending towards the fold of the groin; for, in the former case, the opening of the abscess ought to be made early, whilst, in the second, this operation would only accelerate the death of the patient.

CHAPTER XIV.

PELVIC REGION.

§ 217. We shall comprise in the pelvic region all the portion of the abdomen, situated below the parts of which we have spoken in the two preceding chapters. Inferiorly and externally it is continuous with the thigh, but we prefer here establishing limits entirely arbitrary than separating the description of parts which it is important to study in connexion. We shall, therefore, defer speaking of the parts which surround the hip-joint till the following chapter, when we shall describe the part of the thigh contiguous to the ilium. We shall take, then, for the inferior limit of this region, the outer surface of this bone, and the angle formed by the junction of the perineum and the internal surface of the thigh. We shall also speak successively of this region in the male and female, for most of the parts present such great differences in the two sexes, and an accurate acquaintance with them is so necessary in surgery, that unless this mode were adopted, it would be difficult to unfold with clearness the practical results established on the anatomical arrangement of these parts. We shall first treat of the pelvic region in man.

§ 218. The anterior part of this region is called the *pubes*, and is situated just above the organs of generation; it is covered in the adult with hair. The teguments are of a very firm and serrated texture, of a remarkable thickness, and contain a great number of sebaceous follicles. A thick layer of lamellated cellular

tissue closely unites the skin to the subjacent parts; there is sometimes a great quantity of fat collected in this part. The *penis*, the length and size of which are subject to considerable variation, is a soft, cylindroid organ, and, in the natural state, pendant. During the state of erection, this organ becomes elongated, and assumes almost a triangular shape. Its superior surface or dorsum presents a slight longitudinal groove, in which the dorsal vein of the penis is lodged; its inferior surface, on the contrary, presents a longitudinal projection formed by the urethra, and bounded on each side by a slight sulcus. The skin of the penis is remarkable for its fineness and the great number of follicles which are contained in its substance; towards the root of the penis there are some hairs, but in the remainder of its extent it is quite smooth. The cellular tissue, which unites it to the subjacent parts, is always void of fat, and extremely loose, hence, the integuments may be easily moved in every direction. It is on account of this circumstance, and the tendency which the corpora cavernosa have to contract after the amputation of the penis, that Sabatier has recommended the skin to be drawn a little towards the gland before the commencement of the incision; for, if too much were left, it might obstruct the opening of the urethra. On the other hand, great care must be taken not to retract too much of the integument, for the stump would not then be covered, and the cicatrization of the wound would with difficulty be effected. Towards the top of the penis there is an elongation of the skin, called *prepuce*, which folds on itself, and is continuous with the mucous membrane which covers the gland. This fold of skin varies in length; sometimes it advances even beyond the gland, and then its free edge contracts so as to present but a very narrow aperture. This state, which almost always exists in childhood, may remain in the adult, and cause considerable impediment to the emission of urine, and prevent the gland being exposed during erection. This complaint, which is called phymosis, may also be the result of inflammatory swelling; for the two layers of the prepuce are united by a considerable quantity of extremely loose cellular tissue, which is very likely to

become infiltrated. To remove this deformity, recourse must be sometimes had to an operation, and the prepuce be divided at its upper and middle part, or even a portion of the prepuce be removed. The narrowness of the opening of the prepuce may also occasion a condition contrary to the one we have just mentioned; for if the prepuce be carried beyond the gland, it cannot again be brought over, and a strangulation or stricture of the part takes place. This is called paraphymosis, for the relief of which an operation is also sometimes necessary, as in phymosis.* The extremity of the penis is formed by the gland, which somewhat resembles in form a cone flattened from before to behind, and truncated at its base. Its apex presents a small vertical fissure, which is the orifice of the canal of the urethra; its base forms a kind of ridge, which extends a little beyond the body of the penis, and is called the corona glandis. It is on account of this projection that in paraphymosis the prepuce cannot be returned into its natural situation. The mucous membrane which covers the gland is thin and smooth; there are several papillæ on its surface. Beyond the corona glandis, it forms a kind of cul-de-sac, being reflected to be continued on the internal surface of the prepuce, and to be continuous with the common integuments. Inferiorly, this groove is interrupted by a small fold, which extends from the prepuce to the gland close to the orifice of the urethra; this is called the frænum of the penis. When it is too long or too short, the erection of the penis is accompanied with a very unpleasant sensation, or curvature of the penis downwards; to remedy this defect, this membranous fold must be divided.

§ 219. Below and behind the penis there is a kind of pouch, which lodges the testicles, and is commonly called the purse. It is separated from the anus by a space from two and a half to three inches in length, and is bounded laterally by the depressions which separate it from the thighs. Behind the anus there may

* {This disease may generally be overcome by making pressure on the glans penis with the thumb and fingers. The blood being pressed out, we are at once enabled to draw over the prepuce.—W.}

be felt through the integuments, a projection formed by the coccyx. Lastly, the lateral, posterior, and superior parts of this region are rounded, and continuous with the buttocks.

The skin of the *scrotum* is remarkable for its brown colour, and by its numerous rugæ and folds. During the erection of the penis, in young and vigorous persons, and when the temperature is cold, the skin of the scrotum contracts and rest exactly against the testicle; in old persons and a hot temperature, on the contrary, it becomes loose and elongated. It is not covered with so much hair as the pubes, but contains a greater abundance of sebaceous follicles. The scrotum is divided into two equal portions by a rough and projecting line which extends from the root of the penis to the anus, and which is called the raphe. Lastly, this cutaneous bag is continuous with the skin of the perineum posteriorly, of the thighs externally, and that of the penis anteriorly. It is on account of the prolongation of the scrotum, on the inferior surface of the penis, that in amputation of this organ, the skin must never be divided from above downwards, for the surgeon would run the risk of removing a portion of the integuments of the scrotum.

The arteries of the scrotum are given off from the external pudic, and, in general, are so large as to require to be tied in the extirpation of the testicle. The internal surface of the scrotum is united by means of serrated cellular tissue to the *dartos*, which forms the second layer of the scrotum. This name is given to two cellulo-aponeurotic layers, which appear to be processes of the superficial fascia, drawn to the bottom of the scrotum by the testicles during their passage from the abdomen. Each dartos is attached to the internal edge of the ramus of the pubes and that of the ischium, descends obliquely from without inwards, as far as the raphe, and then ascends towards the urethra, meeting that of the opposite side, and thus forming a vertical septum which separates the two testicles. These membranes are completely deprived of fat, but contain a great number of vessels. The fibres of the *cremaster muscle*, which we have seen

arising from the inferior edge of the internal oblique and transversalis abdominis, form kinds of loops, which surround the spermatic cord and testicles, and which constitute the third layer of the scrotum or tunica erythroides; in the natural state, this muscular layer is very thin, but in scrotal herniæ, or old and large hydroceles, it becomes firmer and considerably thicker. Its outer surface is united to the dartos by a layer of cellular tissue, which is continuous superiorly with the funnel-shaped process which is detached from the circumference of the inguinal ring, and surrounds the spermatic cord. (§ 182.) Its internal surface is in connexion with a cellulo-fibrous covering which constitutes the common tunica vaginalis of the testicle, and of the spermatic cord of Meckel. It is formed of two distinct layers; the external of which is the continuation of the sheath coming from the edges of the superior opening of the inguinal canal (§ 189.); the internal one is continuous with the sub-peritoneal cellular tissue, or fascia propria, and terminates on the superior part of the testicle. (§ 191.) Inferiorly, this tunic is of a dense and fibrous texture, and closely adheres by its internal surface to the proper *tunica vaginalis.* It is of a serous texture, and is formed of two layers of peritoneum, the outer of which adheres to the fibrous membrane of which we have just spoken; the inner one is closely united to the tunica albuginea. In the adult, these two serous layers are closed so as to form a shut sac, which surrounds the testicles and epididymis, excepting at the spot where the spermatic vessels penetrate into this organ, and which is continued higher up anteriorly than posteriorly. In children, on the contrary, the cavity of the tunica vaginalis communicates with that of the peritoneum; hence, we sometimes observe the intestines escape into it and constitute a congenital hernia. (§ 191.) The internal surface of the tunica vaginalis constantly secretes a serous fluid. Hence, when by any cause the quantity of this fluid is increased, a tumour is formed, which is called hydrocele of the tunica vaginalis.

§ 220. The *tunica albuginea* immediately surrounds the testicle; it is a thick, fibrous membrane, having

the form of a sac, perforated at its upper extremity for the passage of the vas deferens, and at its posterior edge for that of the spermatic vessels. The testicle is a soft mass, formed by the seminiferous tubes, and divided into several lobes by blood-vessels. Towards the superior extremity of this organ, these canals unite in a certain number of trunks, which traverse the tunica albuginea, and constitute the vasa efferentia; these unite into a bundle, and form the epididymis. Lastly, this body terminates superiorly in a narrow and tortuous canal, called the *vas deferens*. The testicle, we perceive, then, is surrounded by the tunica vaginalis, and this serous sac extends on the anterior part of the spermatic cord; hence, in cases of hydrocele of this tunic, this organ is situated at the posterior and middle part of the tumour, and consequently the puncture of the scrotum at this part must be avoided, for the fluid would not escape, and the testicle, probably, be wounded.

§ 221. The *superficial fascia* is continued behind the scrotum, as a thin layer of cellular tissue. On the median line, it is entirely deprived of fat, and loosely connects the integuments to the subjacent parts. Laterally, it is thicker, and is attached to the rami of the ischia. Around the anus, it can scarcely be distinguished, for the fibres of the external sphincter muscle adhere very closely to the skin. Behind this muscle, the superficial fascia forms on the median line a small band, which extends from the posterior point of the sphincter to the extremity of the coccyx. Laterally, the subcutaneous cellular tissue becomes looser and thicker, and forms along the whole extent of the nates an elastic cushion, which contributes in great measure to give to this eminence its round and projecting form. From this arrangement, it happens that the tumours which develop themselves in this part may acquire a considerable size, without causing ulceration of the skin, and that the collections of matter in this part rapidly extend to the perineum and thigh, unless they are early opened. But the external sphincter muscles prevent the separation of the skin in the immediate neighbourhood of the anus, as well as the formation of abscesses

in this part, unless they are extremely small and circumscribed.

§ 222. Immediately beneath the cellular layer of which we have been speaking, an aponeurotic membrane is situated, the thickness and appearance of which vary considerably in the different parts of this region. Anteriorly, it gradually degenerates into cellular tissue, and is lost on the scrotum and the fibrous covering of the corpora cavernosa. On the lateral parts of the perineum it is inserted into the rami of the ischia conjointly with the erectores penis. Lastly, a little beyond the posterior edge of the transverse muscle of the perineum, this cellular aponeurotic layer, which may be called the *perineal fascia*, is continued into the *recto-urethral aponeurosis*, which is situated at first deeply in the perineum, then becomes superficial in this point, and covers the inferior surface of the levator ani muscle. The posterior or anal portion of this aponeurosis is very thin, and almost cellular; it sends a great number of white filaments into the fatty cellular tissue on the edge of the anus, and passes beneath the sphincter, to be attached to the rectum. Laterally, it is inserted into the ischium and the falciform edge of the sciatic ligament, forming almost a right angle with the pelvic aponeurosis, of which we shall presently speak. This aponeurosis thus lines the whole inferior portion of the pelvis, and presents several openings for the passage of the subcutaneous blood-vessels; that through which the superficial artery of the perineum, its vein, and nerves pass, is the most important, and is situated near the outer edge of the posterior extremity of the transverse muscle of the perineum. This artery, which is one of the terminating branches of the internal pudic, then proceeds from behind forwards, on the external surface of the perineal fascia, where it is surrounded by fatty cellular tissue. On approaching near to the raphe, it sends a great number of branches to the muscles and integuments of this part, and then passes beneath the ejaculator urinæ, to dip down into the septum of the dartos, and to be distributed to the scrotum, dartos, and integuments. But the direction and size of this vessel are

subject to considerable variations; hence, it is frequently opened in the operation for stone according to Côme. For the purpose of avoiding this accident, it is advised to make the incision from the raphe about an inch from the anus to the level of the top of the ischium, at an equal distance from the ramus of this bone and the raphe, taking care not to get too near to the anus, lest the lower portion of the rectum should be wounded. M. Boyer also recommends to take care not to give the blade of the lithotome caché a direction too much outwards whilst the instrument is withdrawn from the bladder, and at the same time to return it into the sheath when the prostate and neck of the bladder are divided. When this artery is opened in a person not very fat, the orifice of the vessels may be seen in the lips of the wound, and seized with the forceps. Near to its insertion into the sciatic ligament, the anal portion of the urethral aponeurosis presents a small opening for the passage of the *inferior hæmorrhoidal vessels* and the internal pudic nerve. The inferior hæmorrhoidal artery comes from the internal pudic or the inferior branch of this vessel, and after becoming subcutaneous, proceeds transversely inwards to the edge of the anus, where it subdivides, to be distributed to this part, and to anastomose with the neighbouring vessels. In the operation of fistula in ano, it often happens that this artery, or one of its principal branches, is divided, but pledgets of lint are in general sufficient to arrest the hæmorrhage from this accident.

The anatomical relations of the perineal fascia afford us a satisfactory explanation of several phenomena which accompany the extravasation of urine into the perineum. In fact, the tumours which form in this part seldom open externally, but the contents make their way to the scrotum. This is owing to the resistance which this cellulo-aponeurotic membrane opposes inferiorly and externally, where it prevents the descent of the tumours on the thigh by its insertion into the rami of the ischia and pubes. Anteriorly, the ascent is facilitated by the great quantity of cellular tissue placed between this fascia and the layer which unites the scrotum to the subjacent parts. During the forma-

tion of abscesses in this part, the perineal fascia exerts the same influence, and contributes to render the fluctuation obscure; hence, in all these cases, incisions should be made without delay.

§ 223. Beneath the aponeurosis of which we have been speaking, we find a layer of muscles, composed of the *erector penis*, ejaculator urinæ, transversus perinæi, levator ani, and ischio-coccygeus. The first of these muscles is an elongated and flattened bundle, extending on the parietes of the perineum, and attached to the inner side of the tuberosity of the ischium; it proceeds upwards, inwards, and terminates on an aponeurosis, which is continuous with the fibrous membrane of the corpus cavernosum. Its external surface rests on this body and on the ramus of the ischium; the internal is separated from the transverse muscles of the perineum and ejaculator urinæ, by a considerable quantity of fatty cellular tissue, by vessels and nerves. The *ejaculator urinæ* is a small elongated flattened muscle, extending on the side of the raphe from the neighbourhood of the anus to the corpus cavernosum. Its posterior extremity is joined near the verge of the anus with the sphincter, levator, and transversus muscles; the anterior terminates on the fibrous covering of the corpus cavernosum. Its inferior surface is covered by the perineal fascia, the sphincter ani, and erector penis; the superior is in relation with the recto-urethral aponeurosis, the bulb, a portion of the canal of the urethra, and the corpus cavernosum. When this muscle contracts, it pushes the posterior part of this canal upwards and forwards, and compresses it. Hence, it is possible that the impediments which are met with in this point during the introduction of the catheter, frequently depend on spasmodic contraction of this muscle.

§ 224. The *transverse muscle of the perineum*, in general thin and triangular, is situated at the posterior part of the perineum, attached in part to the tuberosity and the ramus of the ischium, above the erector penis and corpus cavernosum; and in part to a tendinous line situated on the raphe. Its fibres take an oblique direction from without inwards and from behind forwards,

are intermixed with the aponeurotic expansions, and continued forwards to different extents, in different individuals. The inferior surface of this muscle is covered by the ejaculator urinæ and erector penis, and by the mass of fatty cellular tissue which separates them. Its superior surface is in connexion with the levator ani, the deep branch of the internal pudic artery, and the perineal portion of the *recto-urethral aponeurosis.* This fibrous membrane joins the perineal fascia behind the posterior edge of the transversus muscle, and is continued posteriorly on the inferior surface of the levator ani. Anteriorly, it is attached to the rami of the ischia and pubes, and beneath the symphysis of these bones, above the insertion of the roots of the corpora cavernosa. About an inch from the arch of the pubes, we observe an opening, destined to give passage to the membranous portion of the urethra, and from the edges of which a prolongation is sent off on the membranous portion of this canal. In front of this opening the recto-urethral aponeurosis appears to double on itself, and form between its two layers a thick bundle of yellow fibres, extending transversely behind the symphysis pubis, and called the subpubic ligament. This ligament occupies the anterior part of the arch of the pubes, to the extent of half an inch: its inferior edge is thick, and generally straight; sometimes it is slightly curved. Most surgeons attribute to this anatomical arrangement the obstacles which the point of the sound so frequently meets towards this part of the canal of the urethra; but from recent investigations it appears that they depend on different causes.

The inferior surface of the recto-urethral aponeurosis is in relation with the transverse muscle of the perineum, Cowper's glands, and the roots of the corpora cavernosa; the superior is separated from the pelvic aponeurosis by the prostate gland. Lastly, the superior branch of the internal pudic artery proceeds from behind forwards between the two layers of this aponeurosis.

§ 225. The *levator ani* forms with its fellow and the ischio-coccygei muscles a kind of concave floor, which complete the lower wall of the abdomen, being merely

perforated for the passage of the extremity of the rectum. This thin and irregularly quadrilateral muscle is attached to the inferior and posterior parts of the symphysis of the pubes, to the horizontal ramus of this bone, above the obturator muscle, and to an aponeurotic arch, extending from the inferior and internal parts of the body of the pubes, to the spine of the ischium, and formed by the separation of the two layers of the pelvic aponeurosis. From these different points the fleshy fibres of the levator ani descend from without inwards; the posterior terminate on the lateral and inferior parts of the coccyx; the central ones unite with those of the opposite side on a kind of tendinous raphe, placed on the median line. Lastly, the interior are continuous with those of the opposite side and with those of the sphincter, near the margin of the anus. The posterior border of this muscle is contiguous to the inferior edge of the ischio-coccygeus; the anterior, inclined downwards and inwards, passes on the prostate and the bottom of the bladder, embraces the lateral part of the rectum, and joins its fellow. The posterior layer of the aponeurotic arch, of which we have been speaking, descends on the inner surface of the obturator internus, between this muscle and the outer surface of the levator ani, and is attached anteriorly to the bottom of the obturator foramen, and inferiorly to the great sacro-sciatic ligament (especially the free edge of its falciform fold,) and even to the ramus of the pubes, forming almost a right angle with the recto-urethral aponeurosis. The triangular space comprised between these two aponeurotic layers is filled with fatty cellular tissue, and is about an inch in extent at its broadest part, and an inch and a half in length. Abscesses which appear at the edge of the anus generally form in this part of the pelvic region; hence, they must be opened early, to prevent the denudation of the rectum, for if the complaint be left to itself, a large hollow would be formed, having for its outer wall the fibrous prolongation of the pelvic aponeurosis, which is firmly attached to the pelvis, and for its inner wall the levator ani and the rectum, the situation of which constantly varies, according as it is full

or empty. After opening abscesses of this part, the integuments unite with difficulty, and the cicatrization is slow and tedious.

§ 226. The *ischio-coccygeus*, situated behind and in front of the preceding, is triangular, and attached by its apex to the spine of the ischium; by its base to the edge of the coccyx, and to the lower and lateral portions of the sacrum. Posteriorly and inferiorly it is in relation with *the two sacro-sciatic ligaments.* The largest of these ligaments, thin, triangular, and directed obliquely from within outwards, above downwards, and a little from behind forwards, is attached, in part, to the posterior and inferior spine of the ilium, the sacrum and edge of the coccyx, and in part to the tuber ischii. The posterior surface of this ligament gives attachment to the glutæus maximus; the anterior is in relation with the lesser sacro-sciatic ligament, the obturator internus, and the pudic vessels and nerves.

§ 227. The *internal pudic*, a branch given off by the internal iliac, or ischiatic, leaves the pelvis by the great sciatic notch between the pyriformis and posterior edge of the levator ani, close to the great sacro-sciatic ligament. It then proceeds downwards, passes between the two sacro-sciatic ligaments, bends on the anterior, and proceeds horizontally forwards and inwards along the internal surface of the ischium, between the obturator internus and levator ani muscles, about an inch and a half from this opening: near the posterior edge of the transverse muscle of the perineum, this vessel divides into two branches; the inferior one proceeds in the manner we have already said (§ 222.); the superior traverses the transverse muscle of the perineum, and proceeds forwards along the ascending branch of the ischium, between the two layers of the recto-urethral aponeurosis, to reach the roots of the corpora cavernosa, when it divides into the dorsal artery of the penis and that of the corpus cavernosum. Almost immediately after its origin. this vessel gives origin to the *transverse artery of the perineum*, which passes inwards and forwards towards the bulb of the urethra. and becomes more superficial the nearer it approaches this part. This artery must frequently be divided in

the operation for stone; but the hæmorrhage from this vessel is never attended with serious consequences, and may be always arrested by pledgets. The division of the deep branch of the pudic artery would be a much more serious occurrence, on account of the size of this vessel and its deep situation. The internal pudic itself ought very rarely to be divided, for this can only be done by carrying the incision much farther outwards and backwards than is necessary in the lateral operations for stone.

§ 228. The anterior extremity of the musculo-aponeurotic layer, of which we have just been speaking, lodges in its substance the roots of the *corpus cavernosum*. This organ is principally formed of a fibrous covering and a spongy tissue, and gives to the penis its form and dimensions. The anterior part is nearly cylindrical, and terminates in a kind of truncated cone, which is united to the base of the gland; its posterior portion is bifurcated to the extent of about two inches. Each of these divisions, which are called the roots of the corpus cavernosum, is attached to the internal base of the rami of the ischium and pubes, and terminate by a very thin extremity near the tuber ischii. In front of the lower portion of the symphysis of the pubes, they unite, and leave between them a triangular space, which lodges the canal of the urethra and fatty cellular tissue. On the dorsal surface of the penis we find a longitudinal sulcus lodging the dorsal arteries and veins. The dorsal artery is one of the terminating branches of the internal pudic (§ 227.); it traverses the recto-urethral aponeurosis in front of the opening which gives passage to the urethra, passes beneath the pubes, through the suspensory ligament of the penis, and proceeds parallel to the artery of the opposite side, to very near the gland, where it terminates. The veins which accompany it unite to form two large trunks, which go to those of the bladder, after receiving the branches coming from the scrotum, &c. The supensory ligament of the penis is a triangular fibrous fold, which is attached to the inferior part of the symphysis of the pubes, and terminates inferiorly by uniting with the fibrous membrane on the dorsal surface

of the penis. If the person is in the erect, or in a completely horizontal position, the anterior wall of the abdomen is put on the stretch, as well as this ligament and the integument covering the penis. Under such circumstances, the penis rests against the symphysis of the pubes, and the spongy portion of the urethra describes a marked curvature in passing beneath this bone. But on relaxing the muscles of the abdomen, the suspensory ligament of the penis allows of this organ being separated a little from the pubes, and by this means the curve is nearly destroyed. On the inferior surface of the corpus cavernosum, there is also a longitudinal groove; it is deeper than the superior, and lodges the anterior portion of the canal of the urethra. The fibrous membrane which envelops the corpus cavernosum is in general very thick and strong, especially near the pubes; the white fibres which form it interlace with each other, and with those of the periosteum of the pubes, and the aponeuroses which are attached to this bone. Lastly, at the anterior extremity of the penis we find between them numerous lacunæ for the passage of the blood-vessels. The interior of this fibrous membrane forms a kind of canal, divided by an incomplete longitudinal septum; from this a great number of filaments are given off, which intersect one another, and contribute to form, with the veins and arteries of this part, the spongy tissue; the numerous cells of which communicate with these vessels, and become filled with blood during the erection of the penis. The arteries of the corpus cavernosum, which are the termination of the deep branch of the internal pudic, occupy the centre of the lateral parts of the spongy tissue of the penis. Hence, in amputation of this organ, the vessels requiring to be tied, must be sought for in this part of the stump as well as near its superior surface. Some of the lymphatic vessels of the penis terminate in the glands in the pelvis, but the greater part go to those in the groin, by which the occurrence of swellings and buboes, when chancres, and other irritating ulcers exist, will be explained.

§ 229. The *canal of the urethra*, situated in part on the inferior surface of the corpus cavernosum, extends

from the extremity of the penis to the neck of the bladder, passing beneath the symphysis of the pubes, and above the inferior extremity of the rectum; its length is in general nine inches, but it may vary from seven to eleven inches. The direction of this canal varies according to the situation of the penis, and the full or empty state of the bladder and rectum. When both these viscera are distended, or inflated with air, for instance, and the penis hangs down, the urethra forms three curvatures in the form of an S; but if, on the contrary, this organ is raised towards the abdomen, one curvature only remains, the convexity of which is turned downwards, and then almost entirely disappears, when the bladder and rectum are empty. Lastly, if the penis were carried forwards so as to form, with the trunk, an angle inclined downwards of about sixty degrees, the urethra is rendered nearly straight, being directed obliquely from before backwards, and above downwards. These differences explain how it is possible to introduce into the bladder, with the same ease, curved and straight sounds; but we shall return to this subject. The different portions of the canal of the urethra present very remarkable differences, in relation to their diameter and organization; we observe prostatic, membranous, bulbous, and spongy portions. The spongy part of the urethra extends from the extremity of the gland to the bulb which is situated in the perineum, below the angle of the union of the root of the corpus cavernosum, about an inch from the anus. The gland to which we refer, (§ 218.) terminates anteriorly in the spongy portion of the urethra. The erectile tissue, which constitutes this part, is continued posteriorly, and surrounds the whole of the circumference of the urethra as far as the bulb; beyond which even it is continued, as we shall presently see. It is surrounded by a very firm, fibrous membrane, which increases in thickness as it approaches to the bulb, and becomes contracted towards its centre. Lastly, the posterior and inferior surface of this membranous portion is connected to cellular tissue, which separates it from the rectum posteriorly, the bulb anteriorly, and the recto-urethral aponeurosis inferiorly.

§ 230. The *bulb of the urethra*, examined externally, appears formed by an oblong dilatation which terminates posteriorly, the spongy tissue that surrounds the anterior portion of this canal. This enlargement is continued posteriorly below the urethra, and is united to the inferior extremity of the rectum and sphincter muscle by thick and serrated cellular tissue. It is separated from the integuments only by the ejaculator urinæ and perineal fascia; hence, it can be easily felt through the skin. The superior surface of this portion of the spongy body presents a sulcus, which lodges the urethra, being continued anteriorly with the kind of sheaths which surround this canal, and terminated posteriorly by a band formed by the fibrous membrane, enveloping the spongy tissue. Laterally, this part is in connexion with the ejaculatores urinæ, and the roots of the corpora cavernosa. Superiorly, it corresponds to the glands of Cowper, the extremity of the membranous portion of the urethra, and the recto-urethral aponeurosis. The *glands of Cowper* are small oblong bodies, of the size of a pea, and a reddish colour, placed parallel in front of the prostate, on the sides of the urethra, and above the ejaculatores urinæ. Each of these bodies is provided with an excretory duct, which proceeds obliquely forwards and inwards into the spongy tissue of the urethra, and opens into this canal after a course of about six lines.

§ 231. The membranous portion of the urethra is separated from the bulb by its posterior, and the spongy part by its superior surface, about six lines from the symphysis of the pubes. It then proceeds obliquely upwards and backwards, so as to form a curve with the portion of the spongy body, which is continued posteriorly towards the anus. The curvature of the urethra in this spot is much diminished, when the penis is stretched out, and does not then offer any opposition to the introduction of straight sounds into the bladder. This portion of the urethra is joined by firm cellular tissue to the space between the roots of the corpora cavernosa, as well as to the posterior ligament of the pubes, and traverses the opening of the recto-urethral aponeurosis. It is then surrounded by the most ante-

rior fibres of the levator ani which are attached to the symphysis pubis, and is regarded by some anatomists as forming a distinct muscle. A fibrous prolongation, which arises from the edges of the opening in the recto-urethral aponeurosis, surrounds it, and this becomes continuous with the fibrous covering of the prostate. Lastly, the posterior and inferior surface of the membranous portion is united to firm and fibrous cellular tissue, which separates it from the rectum posteriorly, the bulb in front, and the recto-urethral aponeurosis.

§ 252. The superior extremity of the urethra is surrounded by the prostate gland to the extent of about an inch and a half, and has the form of a cone, the apex of which is directed forwards. It is placed behind the symphysis of the pubes, and is attached to the rami of these bones by the anterior ligaments of the bladder. In the first place, it proceeds obliquely from above downwards, and behind forwards, whilst, in the second, it becomes oblique from below upwards and from behind forwards.

The *prostate* is formed of the assemblage of a great number of mucous follicles, inclosed in an aponeurotic membrane. Its size varies according to the age of the individual; but its form is always that of a flattened cone, the base of which is hollowed and turned backwards, and the apex directed forwards, and terminating in the membranous portion of the urethra. In an adult its height is about thirteen lines on the median line, and its breadth nineteen lines; it is about ten or twelve lines thick near its base. Its axis is nearly horizontal and directed obliquely downwards and forwards. Its superior surface is covered by the portion of the pelvic aponeurosis, which is called the inferior ligament of the bladder, and is separated from six to eight lines from the symphysis of the pubes. Inferiorly, it is joined to the rectum and to the recto-urethral aponeurosis by condensed cellular tissue. Lastly, its base surrounds the neck of the bladder, and forms on the sides a more considerable projection than in any other part. In general, this gland is perforated from its base to the apex by a canal, the centre of which is larger than its extremities, and is also traversed by the posterior portion

of the urethra. Sometimes the lateral lobes of this gland do not unite above the urethra, which is only lodged in a kind of sulcus. In most persons, however, this canal is situated from seven to eight lines from the middle and inferior part of the prostate, about eight lines from the outer, ten or eleven from its outer and lower, and three or four from its upper parts. The middle and lower portion of this gland extends a little beyond the two lateral parts, and constitutes what Sir E. Home calls the middle lobe of the prostate. When this body becomes enlarged, it pushes the lower portion of the neck of the bladder backwards, and the corresponding portion of the urethra forwards, so as considerably to compress this canal, and to render the introduction of a sound or catheter very difficult. At other times this canal is flattened by the enlargement of the lateral lobes: hence, Sir E. Home conceives a morbid state of the prostate to be one of the most frequent causes of retention of urine.

§ 233. The *vasa efferentia* also traverse the substance of the prostate; they are formed by the junction at an acute angle of the vasa deferentia, with the excretory ducts of the vesiculæ seminales. These canals are of a conical shape, about an inch in length, and proceed in a parallel direction forwards and inwards into the substance of the gland, to open on the inferior surface of the canal of the urethra, where they are surrounded by the excretory ducts of the prostate. The *vesiculæ seminales* are two membranous sacs, of a conoid shape, about two inches and a half long, and half an inch broad towards their base. They are situated in a mass of fat behind the prostate, above, and in front of the rectum, to the inner side of the levatores ani muscles and outer side of the vasa deferentia. Taking an oblique course from without inwards, and above downwards, these vesicles become separated from each other posteriorly, but their apices are long and narrow, and are only separated by the vasa deferentia to which they are united. Lastly, these ducts pass from before backwards, and within outwards, then change their direction and ascend on the sides of the bladder, to leave the abdomen by the inguinal ring.

§ 234. The *canal of the urethra*, the external configuration and relations of which we have just considered, is lined internally by a mucous membrane, which is continued forwards with that which covers the gland; and, posteriorly, with the membrane lining the interior of the bladder. The diameter of this canal is not the same in all its extent; immediately behind its external orifice, which is rather narrow, it presents a dilatation, called *fossa navicularis*. Beyond this point the spongy portion of the urethra increases in size, and its diameter, at the posterior part, according to M. Lisfranc, is from five to seven lines.* Immediately above the bulb, the membranous portion considerably contracts; at the spot where it traverses the recto-urethral aponeurosis, its breadth is scarcely from two to three lines and a half; but near the prostate its diameter is from four lines and a half to five lines. Lastly, the prostatic portion of the urethra is from four to five lines and a half broad at its centre, and from three to four lines at its extremities. Moreover, it is evident, that these diameters must be subject to great varieties in different persons.

The inferior surface of the canal of the urethra is perfectly smooth near the gland, but in the rest of the spongy portion, we observe folds and small mucous follicles, the openings of which are situated on the median line and directed forwards. At the point of junction between the bulb and the membranous portion of the urethra, where this canal is most contracted, the orifices of the excretory ducts of Cowper's glands are situated. Lastly, towards the superior extremity of the prostatic portion, the parietes of the urethra presents a small eminence called the *verumontanum*. The point of this eminence is perforated by the openings of the vasa efferentia, and on its sides are

* According to Sir E. Home, the diameter of this portion of the canal of the urethra, at the distance of nine lines from the meatus urinarius, is about five in an old person, and four lines in an adult. At the distance of four inches and three lines from this point, its breadth is four lines in the two individuals. Lastly, at six inches and six lines near the bulb, it is from seven lines to seven lines and a quarter.

arranged, in the form of a semicircle, the openings of the excretory ducts of the prostate. This ridge divides this part of the lower parietes of the urethra into two grooves, behind which there is generally a transverse projection which unites at right angles with the verumontanum, and establishes the boundary between the bladder and urethra. Hence, it is more generally in one of these lateral fossæ, that the point of the instrument stops in the introduction of the catheter, than against the kind of valve formed by the mucous membrane round the openings of the vasa efferentia. On passing the finger over this part of the urethra, whilst the canal is kept on the stretch with the other, there may be felt near the bulb an enlargement; but a little beyond this the finger will be stopped by the fibrous edge at the commencement of the bulb. (§ 230.) M. Amusat, who has particularly noticed this fact, attributes to this condition of the urethra, and not to the recto-urethral aponeurosis, the impediments so frequently experienced in this spot in introducing an instrument into the bladder, and the false passages which are so frequently formed. In pursuing the examinations of the membranous portion of the urethra, nothing remarkable is met with unless the prostate be diseased; for then the demarcation between this body and the part of the canal situated below it, may be distinctly felt. But when the finger reaches near the bladder it is again arrested by a transverse band, formed by the fold of the mucous membrane, which is raised by the sphincter muscle of the bladder and the prostate; this is the transverse ridge, situated above the verumontanum, and of which we have already spoken. The superior wall of the urethra presents also numerous lacunæ on the median line; but it essentially differs from the inferior in having no depression. On gliding the end of the finger along this wall, no opposition is experienced, excepting in front of the opening of the recto-urethral aponeurosis; with this exception, the finger easily gets into the bladder. Hence, M. Amusat recommends the end of the instrument to be carried along the upper wall of the urethra, when the surgeon wishes to introduce one into the bladder,

since, at the inferior part, there are two obstacles; the one, the fibrous cul-de-sac of the bulb, the other at the posterior part of the prostate.

§ 235. The *bladder*, a musculo-membranous sac, destined to serve as a reservoir for the urine, is a continuation of the canal of which we have just spoken, and occupies the anterior and superior part of the pelvis. In the adult, the form of the bladder is conoid, and its size rather considerable; when it is distended by the urine, it is raised above the level of the symphysis pubis, and becomes oblique from above downwards and from before backwards. When, on the contrary, it is empty, it falls to the bottom of the pelvis, passes a little to the left, and is pushed towards the pubes, and in the same direction as the membranous portion of the urethra, according as the rectum is full or empty. In infants, the bladder is cylindroid, and is elongated from below upwards. Hence, although it forms a considerable projection above the superior aperture of the pelvis, its inferior extremity and the prostate retain their natural situation, and the direction of the canal of the urethra appears the same as in the adult.

The inferior portion of the bladder is called its neck, and is continuous with the prostatic portion of the urethra. The demarcation between these two parts is seldom well marked, except at the lower part of their internal surface. Before and on the sides, the neck of the bladder is surrounded by some loose cellular tissue, which lodges a kind of venous plexus, and separates this organ from the symphysis pubis, the levator ani muscle, and pelvic aponeurosis.

Posteriorly and inferiorly, it is in relation with the rectum, and is continuous with the fundus of the bladder, which is bounded posteriorly by a fold of peritoneum; this membrane extends from the bladder to the rectum, the lateral portions of which it joins to the sacrum. This part of the bladder is intimately connected with the ureters, vasa deferentia, and vesiculæ seminales. The vesiculæ seminales, directed obliquely from behind forwards, and from without inwards (§ 233), divide the fundus of the bladder into three portions;

the two lateral, convex, and situated on the outside of the vesiculæ, are separated from the levator ani muscle by a great quantity of fatty cellular tissue. The middle is triangular, and situated between the vesiculæ; its base, turned backwards, corresponds to the peritoneum, and its apex, directed forwards, is contiguous to the prostate. Lastly, it is intimately united to the middle part of the rectum, by cellular tissue. An exact knowledge of the relations of this part of the bladder with the rectum and vasa efferentia, is of great importance to the surgeon, as we shall soon see, when speaking of the recto-vesical operation.

The superior surface of the bladder is covered to a great extent by the peritoneum, and is in relation with the small intestines. Towards its centre, it is continuous with the *urachus*, a kind of fibrous cord, which ascends, between this membrane and the linea alba, to terminate at the umbilicus, where it joins the abdominal aponeurosis. (§ 188.) The umbilical arteries which arise from the internal iliac, proceed obliquely forwards and inwards, and around the lateral and superior parts of the bladder, before they make a curve, in order to ascend towards the umbilicus, and join the urachus. Lastly, the anterior part of the superior surface of the bladder is not, in general, covered by the peritoneum; for this membrane, when it reaches in front of the insertion of the urachus, proceeds upwards, and rests on the posterior surface of the parietes of the abdomen, some distance above the symphysis pubis. Thus the anterior surface of the bladder is never covered by the peritoneum, and if this viscus is distended, so as to make a projection above the pubis, it is directly in contact with the rectus muscle. Behind the symphysis pubis, the anterior surface of the bladder is covered by a great quantity of fatty cellular tissue, and rests inferiorly on the superior and posterior edge of the prostate. Lastly, it is attached to the pubis by the anterior ligament of the bladder, a small fibrous sheath, belonging to the pelvic aponeurosis.

The interior of the bladder is lined by a mucous membrane, which is continuous with that of the urethra, and presents, in a state of contraction, a great

number of rugæ. When the fleshy bundles of the bladder are developed, these rugæ may always be observed, together with some elongated projections, intersecting each other in different directions, and separated by cells. The existence of these bundles appears to favour very much the formation of urinary calculi, which often cause the dilatation and lengthening of the cells, and transform them into cul-de-sacs. The calculi are lodged in these, increase in size, and cannot escape, in order to become free in the cavity of the bladder. This arrangement is, then, one of the causes of the formation of encysted calculi. The fundus of the bladder is situated on a plane less elevated than its urethral opening; hence, when a sound is introduced into this viscus, in order to ascertain the existence of a calculus, the point of the instrument must be carefully depressed, and carried from right to left, to sound the most dependant part of the bladder. A smooth triangular space is here observed, about an inch long, the anterior angle of which corresponds to the origin of the urethra, and the posterior to the opening of the ureters.* The orifices of the ureters are narrow and oblique; the canals pass outwards and backwards, between the tunics of the bladder, and after a course of about an inch, pass from the walls of this viscus, to ascend towards the kidneys, as we have before said. (§ 216).

§ 236. From the anatomical details which we have given in the preceding paragraphs, it appears that there are three different spots at which the bladder may be opened, either for evacuating the urine, or extracting calculi; the first is at its anterior and superior surface, above the pubes; the second, at its inferior and anterior part, through the perineum; and the last, at its posterior and inferior part, by the rectum. We shall defer the description of this last operation until we speak of the rectum. In order to perform the high operation, or that above the pubes, it is necessary that the bladder should rise above the superior edge of the pubes, which does not take place when this viscus is

* It is called *trigóne vésical* by the French anatomists.

empty; hence, it is necessary to begin by distending it with injections, or waiting till sufficient urine is accumulated to produce the desired effects, or by elevating the anterior and superior part, by means of a sound, the point of which must be made to glide from below upwards, against the posterior surface of the pubes. The external incision must be made vertical, on the median line of the body, immediately above the pubes, and about two inches in length. Then the linea alba must be divided, taking care not to open the peritoneal cavity. The surgeon commences by making an opening about two or three lines immediately above the pubes, in the spot which corresponds to the space which we have before described as being filled with fatty cellular tissue, and bounded inferiorly and posteriorly by the bladder, and superiorly by the peritoneum, which is reflected on the wall of the abdomen only at a certain distance above this bony arch. A grooved director is then introduced between the aponeurosis and peritoneum, which serves to guide the knife in the division of the linea alba. Lastly, the operator endeavours to feel with his finger the extremity of the sound, before introduced into the bladder, and then divides the anterior wall of this organ. This method of operating is superior to others, since no fatal hæmorrhage is to be feared, and because the surgeon can make a much larger opening without fear of wounding any important part, and can, consequently, extract the largest calculi. On the other hand, from the anatomical relations of the different parts, this mode of operating is not altogether free from objections. In fact, the irritation caused by the presence of a calculus in the bladder sometimes produces such a state of permanent contraction of this viscus, that it becomes impossible to dilate it so as to make it project above the pubes, and to separate the peritoneum sufficiently from the parietes of the abdomen, so that the instrument shall not traverse this membrane before it penetrates into the urinary bladder. Then the urine, escaping with greater facility by the wound than by the canal of the urethra, comes away for a long time by this opening; or it may, in consequence of the wound of the linea alba and that

of the bladder not being parallel, pass into the cellular tissue of the pelvis, and cause very serious symptoms. To avoid this occurrence, some surgeons have advised the making, at the same time, an opening into the neck of the bladder, by the perineum; but it would appear, from Sir E. Home's observation, that the presence of a catheter in the bladder would be sufficient to remedy this inconvenience.

§ 237. The lateral operation for stone has been modified by a great number of surgeons; in the mode employed by most of the old French surgeons, the skin of the perineum is divided on the left side of the raphé, and parallel to it, from the scrotum to about a finger's breadth from the anus. The urethra is then divided to an extent equal to that of the external wound, and the rest of the canal is dilated, or rather torn, to penetrate into the bladder. The incision of the spongy part of the urethra cannot serve in any degree for the extraction of the stone, and would often cause infiltration of the blood and urine into the cellular tissue of the scrotum. Hence this method is at present abandoned. In the lateral operation, the surgeon begins the incision of the integuments at the raphé, about an inch in front of the anus, and terminates it between this opening and the tuber ischii. The fatty cellular layer comprised between the erector penis, as well as the fibres of the transversus perinei muscles, is then divided (§ 224.); after which the membranous portion of the urethra, the lateral part of the prostate gland, and the neck of the bladder. From the manner in which we have seen the bulb of the urethra continued posteriorly, from the point where the membranous portion is separated from the spongy portion of this canal, it is evident that it is scarcely possible to avoid dividing this part. This is always useless, and may even be troublesome on account of the great number of vessels which pass to this part. In order to avoid it with greater certainty, some surgeons advise the operator to push the internal lip of the wound inwards with the thumb of the left hand, and to cut on the nail of this finger. A division of the trunk of the internal pudic artery would be a much more

serious occurence; but this is very rare, for, to reach this vessel, the incision must be extended downwards and outwards, and even as far as the bony parts of the pelvis, against which the artery rests (§ 227.) If, on the other hand, to avoid this accident, the operator does not carry the incision with a sufficient degree of obliquity outwards, he runs the risk of wounding the rectum. The direction which ought to be given to the incision of the prostate, and its extent, are also points of the greatest importance for the success of the operation. As Scarpa justly observes, the operator must take great care to divide the base of this gland to the extent of eight lines, as well as the orifice of the bladder, and a portion of this viscus. For, if the prostate gland be completely divided, the lips of the wound would not be kept in contact posteriorly, and nothing would oppose the infiltration of the urine in the surrounding cellular tissue. It is always necessary then to leave a small portion of the posterior edge of the prostate untouched, whilst the top of this gland ought to be completely divided, for this is the part which most opposes the extraction of the stone. The direction of the incision, according to Scarpa, ought to be obliquely downwards and outwards; so as to make with the axis of the neck of the urethra and prostate gland an angle of sixty-nine degrees. For a larger opening can in this way be made, with safety to the patient, than by carrying the incision directly outwards, as M. Boyer advises, in order to avoid the rectum and pudic artery.

Lastly, in the transverse, or bilateral operation, the surgeon makes a semilunar incision, the centre of which is situated in front of the rectum, behind the bulb, and the extremities of which are turned outwards and backwards towards the tuberosities of the ischia. Then the membranous portion of the urethra is opened, and the incision extended from right to left in the substance of the prostate; so as to form a triangular flap, which contains the vasa efferentia and verumontanum, and the inferior half of the prostatic portion of the urethra. By this means, an opening much larger than by the lateral operation is obtained, and

the injury of the ducts of which we have just spoken, is more certainly avoided; there is no hæmorrhage of importance to be dreaded.

§ 238. The *rectum* terminates inferiorly the large intestines, and occupies the posterior part of the pelvis. It is a continuation of the sigmoid flexure of the colon, and begins on a level with the sacro-vertebral articulation of the left side; at first a little inclined from left to right, it soon becomes vertical, and describes a curve, the convexity of which is turned backwards, and corresponds to that of the os sacrum. Lastly, when on a level with the inferior extremity of the coccyx, it curves backwards, and terminates at the anus, situated at about an inch in front of this bone. The rectum is cylindrical in the greater part of its extent, but near its inferior extremity, it presents a dilatation, and is surrounded by a great quantity of fatty cellular tissue. The anterior surface of this intestine is separated from the membranous portion of the urethra by a triangular space, the base of which corresponds to the integuments of the perineum, and the apex to the prostate. The oblique direction of this part of the rectum very much influences the complete success of the operation for stone: in fact, when it is continued forwards, and when the dilatation, of which we have just spoken, is well marked, it often becomes difficult to avoid injuring it, especially in the bilateral operation. Above this point, the rectum is in relation with the vesiculæ seminales, the prostate, the vasa deferentia, and bottom of the bladder (§ 235.), and above which the fold formed by the peritoneum is situated, which passes from the bladder to the rectum.

It is evident then, if the external sphincter of the anus and inferior portion of the rectum be divided on the median line, and in the direction of the raphé, the inferior surface of the prostate will be exposed, and it will then be easy to separate with the finger the intestine from the bladder, and open the bottom of this viscus, or the prostatic portion of the urethra, on the median line, and penetrate into the bladder by its neck. By following the first mode, the operator must

take great care not to extend his incision of the bladder more than two inches beyond the edge of the prostate; for, by this step, he would run the risk of dividing the fold of peritoneum which is situated between the superior part of this viscus and the rectum. On the other hand, if the incision be not made on the median line, he would wound the vasa deferentia, or the vas efferens, an occurrence which would cause the atrophy of the corresponding testicle. No great hæmorrhage is to be feared in either operation.

The posterior surface of the rectum is covered by loose and fatty cellular tissue, which separates it from the levator ani and ischio-coccygeus muscles, from the coccyx and sacrum, and which lodges in its substance numerous branches of the sacro-median artery, as well as the hypogastric vessels and nerves. The peritoneum, as we have before said, is not reflected on the anterior surface of this intestine till just above the level of the fundus of the bladder, and forms, in this spot, two semilunar folds, called the posterior ligaments of the bladder, and separated by a rather deep cul-de-sac. Posteriorly, it forms a fold which is called the meso-rectum, which is larger above than below, and is continuous superiorly with the meso-colon. The inferior part of the rectum is attached in a very strong manner to the parietes of the pelvis. Hence it is scarcely ever subject to accidental displacements; but this is not the case with its superior part, and that portion of the colon with which it is continued. One of the causes of prolapsus ani is the invagination of these intestines, and their descent across the inferior portion of the rectum and anus. Sometimes, this disease is situated entirely in the anal portion of the rectum; but then it only consists in a relaxation of the mucous tunic of the intestine, and does not wholly depend on the displacement of this organ.

The inferior mesenteric artery, after having given off the colicæ sinistræ (§ 214.), descends along the posterior surface of the rectum, and takes the name of *superior hæmorrhoidal artery.* Its branches ramify in great number in the parietes of this intestine, and anastomose with the neighbouring vessels. The *middle*

hæmorrhoidal artery, a small branch generally given off from the internal iliac, descends between the rectum and fundus of the bladder; but it is often wanting, and is never of sufficient size to demand our attention. A great number of veins accompany these arteries, expand around the rectum and anus, and contribute to the formation of the vena-portal system. Hence, many surgeons justly think that the margin of the anus is the spot where leeches produce the greatest effect in phlegmasia of the large intestines.

§ 239. The pelvic aponeurosis, of which we have had several times occasion to speak, is attached anteriorly to the base of the symphysis and body of the pubes, as also to the inferior edge of Gimbernat's ligament; laterally, to the ilium above the insertion of the internal obturator muscle, where it is continuous with the iliac aponeurosis, and posteriorly, to the superior part of the pelvic excavation, on a level with the sacro-iliac articulation, a little below the superior opening. From these different points of attachment, the aponeurosis is extended into the cavity of the pelvis, surrounds the rectum, and is reflected on the fundus of the bladder and on the prostate. Very near the symphysis pubis, this membrane passes towards the neck of the bladder, and forms, on each side of the median line, a small fibrous column, which connects this organ to the pubes, and is called the anterior ligament of the bladder. A little more externally, the pelvic aponeurosis extends on the superior surface of the levator ani muscle, is attached immediately below it, then covers the lateral parts of the prostate, and is lost in the bladder. Above the insertion of the internal obturator muscle, it descends on it, and, arrived at the superior edge of the levator ani, divides into two layers, one of which lines the superior surface of this muscle, and passes on the lateral parts of the bladder and rectum, where it is continuous with that of the opposite side. The other descends between the external surface of the levator ani and internal obturator muscles, to be attached, anteriorly, to the inferior edge of the foramen ovale, and posteriorly, to the great sacro-sciatic ligament. Lastly, behind the obturator muscle, the pelvic aponeu-

rosis is attached to the spine of the ischium, and is continued in the form of a thin cellular layer, on the nerves and vessels which traverse the great sciatic notch, on the ischio-coccygeus muscle; it then terminates on the edge of the sacrum and coccyx. It is evident, from this description, that the pelvic aponeurosis surrounds all the soft parts of the pelvis, and, consequently, opposes the passage of the viscera by the openings of which we have just spoken. Occurrences of this kind are very rare, but they sometimes happen. It is between the rectum and bladder that the aponeurosis is the least yielding; hence, it is near this spot that herniæ of the perineum are formed. The existence of this kind of aponeurotic septum might also occasion differences, which are observed after operations for the stone, according to the distance to which the cutting instrument is carried outwards. In fact, if the solution of continuity is not deep, the small quantity of pus which forms very easily escapes; when the instrument penetrates beyond the pelvic aponeurosis, this liquid cannot escape with the same facility, and it sometimes forms, in the pelvis, abscesses, the consequences of which are, for the most part, fatal.

§ 240. The *internal iliac artery*, one of the branches in which the common iliac terminates, descends almost vertically in front of the sacro-iliac articulation, and soon divides into a great number of branches. It rests on the lateral parts of the sacrum, and sacro-lumbar nerves, and is covered by peritoneum, the ureter, vas deferens, &c. The deep situation of this vessel, and the importance of the parts which surround it, have induced some to believe that it could not be tied, but the operation has been performed, in the following manner. The lateral and inferior part of the abdomen is divided parallel to the course of the epigastric artery; then the peritoneum must be detached from the surface of the iliacus and psoas muscles, in the direction of a line extending from the anterior and superior spinous process of the ilium to the spot where the common iliac bifurcates; and lastly, the operator, laying hold of the internal iliac between his fore-finger and thumb, ties it.

§ 241. The first branch given off by the internal iliac is the *ilio-lumbar artery*, which ascends behind the psoas muscle, in front of the sacro-lumbar nerve, to divide into two branches, which do not present any thing remarkable. The *gluteal artery* is given off a little below the preceding and lateral sacral, proceeds downwards, outwards, and backwards, to pass out from the pelvis by the superior part of the sciatic notch, above the pyriformis muscle between the sacro-lumbar and first sacral nerves. The umbilical artery, of which we have before spoken, arises from the anterior part of the internal iliac, and passes obliquely forwards and inwards towards the lateral and superior part of the bladder. The *vesical arteries*, the number and origin of which vary very considerably, arise, in general, from the preceding, or the internal iliac, the middle hæmorrhoidal, or from the internal pudic and obturator; they are distributed on the fundus of the bladder, prostate, &c. Sometimes, a rather considerable branch from the internal iliac passes along the lateral and inferior part of the prostate, and constitutes the dorsal artery of the penis. If this anomaly existed in a person on whom the bilateral operation for stone was performed, it is probable that a fatal hæmorrhage would be the result, as occurred to the late Mr. Shaw, an account of whose case is recorded in the *London Medical and Physical Journal* for January, 1826. In fact, it would be impossible to recognise, *à priori*, the existence of this vessel; its division would be almost certain, and its depth is such, that the operator would have no knowledge of the occurrence sufficiently early to arrest the hæmorrhage.

§ 242. The *obturator artery* arises, in general, from the internal iliac; but it often comes from a trunk which is common to it and the epigastric. In the first case, this vessel passes forwards and outwards, turns round on the obturator internus muscle, and passes from the pelvis by a small canal formed by the obturator ligament, and a fold of the superior edge of the pelvic aponeurosis. When, on the contrary, the obturator artery arises from the crural, or from a trunk common to it and the epigastric, it enters into the pel-

vis, by passing above the horizontal ramus of the pubes. Sometimes it descends, very soon after its origin, into the pelvis, and passes on the outer side of the crural ring; but, at other times, it surrounds this opening before it reaches the foramen ovale. When this distribution exists, the obturator artery would be unavoidably wounded in dividing the stricture in crural hernia according to the usual method, provided the incision were carried beyond two or three lines in extent. (§ 198.)

The opening by which the obturator artery escapes from the pelvis is formed by a sulcus at the superior and internal parts of the foramen ovale, and by the aponeuroses of which we have been speaking. This opening also gives passage to the obturator vein and nerve, and may, sometimes, admit of the passage of a portion of intestine. In hernia of this kind, the vessels and nerves are always situated behind the hernial sac, which projects at the superior and internal part of the thigh.

The obturator ligament which lines the foramen ovale, excepting at the spot of which we have just spoken, gives attachment by its internal surface to the obturator muscle, and is fixed to the edges of this bony aperture. The *obturator internus muscle* is also inserted into the posterior surface of the pubes, and is covered by one of the layers of the pelvic aponeurosis. It is contained in a cavity partly bony and partly fibrous, that merely allows of the passage of the tendon of the muscle; this turns round the edge of the small ischiatic notch, and passes out of the pelvis to be attached to the fossa at the root of the trochanter major.

§ 243. The terminating branches of the internal iliac artery, are the *ischiatic* and internal pudic. The former of these vessels passes almost vertically downwards between the rectum and parietes of the pelvis, and passes from this cavity by the inferior part of the great sciatic notch, between the lower edge of the pyriformis muscle and the anterior sacro-ischiatic ligament, and in front of the great sciatic nerve. The pudic artery descends vertically in front of the sciatic plexus and pyriformis muscle, towards the great sciatic notch, by the upper part of which it leaves the pelvis, to proceed between the two

sacro-ischiatic ligaments, and to be distributed in the manner we have already mentioned. The *sciatic plexus* formed by the anterior branches of the fifth lumbar and four first sacral nerves, occupies the posterior and lateral portions of the pelvis, and is in relation anteriorly with the internal iliac vessels, the rectum, and a great quantity of fatty cellular tissue. Its principal branches are the hæmorrhoidal nerves, which are distributed to the rectum, the vesical, gluteal, and the great sciatic nerve which leaves the pelvis by the great sciatic notch. The posterior surface of the sacral plexus is in relation with the *pyriformis muscle*, the fibres of which are attached to the anterior surface of the sacrum, to the posterior sacro-sciatic ligament, and superior and posterior part of the ilium, and pass outwards and a little downwards, through the sciatic notch, to be inserted into the fossa at the root of the great trochanter.

To terminate the description of the parts contained in this region, we ought to treat of the bones of the pelvis; but we will defer their description until we have examined the female organs of generation in the same manner as we have the male.

§ 244. At the anterior part of the pelvic region of the female, the *mons Veneris* is situated, a rounded eminence, covered with hair, and formed by the accumulation of fat, in the sub-cutaneous cellular tissue situated in front of the pubis. Immediately behind this spot, the external organs of generation, or vulva, are situated. The skin, by folding on itself, to be continued with the mucous membrane of the vagina, forms, on each side of the opening of this organ, an elongated eminence. The size of these membranous folds, which are called *labia majora*, appears to depend on that of the individual. Their external surface is covered with hair, and is contiguous to the superior and internal part of the thigh; the internal, red and smooth, presents all the characters of a mucous membrane. The anterior extremity of the labia majora is continuous with the mons Veneris: the posterior forms a kind of transverse band, situated at about an inch from the anus, and called the fourchette. In the substance of these membranous folds, a very great quantity of fatty

cellular tissue, analogous to that of the mons Veneris, is situated. Hence, it is not rare to find young women affected with inflammation of these parts. In young girls who have not menstruated, these complaints are, on the contrary, very rare, which admits of an easy explanation; for at this time, the greater lips are very little developed, and inclose but a small quantity of cellular tissue.

§ 245. The *clitoris*, placed at the anterior and middle part of the vulva, between the labia majora, corresponds to the penis in man. In general, there is only a small projecting tubercle; but it sometimes happens that it increases so much as to pass beyond the level of the greater lips. Its length and size may even surpass the dimensions of the penis. This mal-formation considerably impedes coition, and is often so distressing as to require the aid of a surgeon. Amputation of the clitoris does not present any thing remarkable, and the only difference between it and the amputation of the penis is, that it is not necessary to draw the integuments towards the pubis before they are divided. The free extremity of the clitoris is round, and inclosed by a fold of mucous membrane, analogous to the prepuce, and continued on the sides with the lesser lips. The corpus cavernosum of the clitoris is attached beneath the symphysis pubis by a suspensory ligament. Posteriorly, it is bifurcated as in man, and its roots terminate on the rami of the ischia. The *erector clitoridis muscle* arises, as in man, on the outer side of the inferior extremity of the branches of the cavernous body, and is attached to the external surface of the ascending ramus of the ischium. The labia minora, or nymphæ, are kinds of elongated ridges, formed by folds of the mucous membrane of the internal surface of the greater lips, and containing in their substance a thin layer of erectile tissue. In general, the nymphæ are completely covered with the greater lips; sometimes, however, they descend so low as to cause considerable inconvenience during coitus and walking. But this deformity may always be easily cured by means of the knife.

§ 246. Behind the clitoris a triangular and concave

surface is situated, which is called the vestibule; it is bounded anteriorly by the symphysis pubis; externally, by the rami of these bones, by the cavernous bodies and labia majora; and posteriorly, by the urethra; laterally, it extends between this organ, the vagina, and bones of the pelvis. It is in this part that M. Lisfranc advises the incision to be commenced in the operation for stone.* The *meatus urinarius* is, in general, separated from the inferior surface of the clitoris to about four or five lines; but it is easy to increase this distance by depressing the urethra. In most women this opening is generally surrounded by a small eminence more projecting on the side of the vagina than in front, and which may, consequently, serve as a guide in the introduction of an instrument into the bladder. During pregnancy, the meatus urinarius is often drawn inwards, and very difficult to discover. The entrance of the vagina presents in virgins a membranous fold, the size and form of which are subject to considerable variation; this is called *hymen*. This membrane is sometimes not perforated, and completely closes up the entrance of the vagina; no inconvenience arises from it before the age of puberty; but then the menstrual blood, not making its escape externally, causes symptoms which sometimes resemble those of preg-

* {Dr. H. G. Jameson, of Baltimore, has adopted a modification of Lisfranc's method, with a view of healing the wound by the first intention. He performs the operation by introducing a common director into the urethra—a small scalpel is then passed in, with its edge upwards, and pressed inwards and upwards till it makes a wound about three-fourths of an inch upwards, and as far inwards;—the patient lying on the back. The knife is now placed carefully in the groove of the director, and with its edge nearly lateral, towards the left side, but a little downwards, to avoid wounding the pudic artery. In making the last division of parts, or in pushing the knife into the bladder, it should be so held as to make a moderate angle between the director and knife; and thus secure a wound sufficiently large to admit the forceps easily—and it should never be larger. By this operation a large calculus may be extracted. It has been performed twice by Dr. J., and once by Dr. Physick, who, we learn, is much pleased with it. For the detail of Dr. Jameson's cases, see American Medical Recorder, No. 44, p. 347.—W.}

nancy, but which soon disappear when the hymen is opened.

§ 247. When the integuments and mucous membrane which covers the parts of which we have just spoken, have been elevated, a layer of condensed cellular tissue, which is continuous with that lodged in the substance of the labia majora, is exposed; this covers the *constrictor vaginæ.* This muscle is analogous to the ejaculator urinæ; it surrounds the vagina, and its fibres interlace in front of the anus with those of the sphincter and transversus perinei muscles. Anteriorly, it extends into the vestibule, and often to the anterior part of the branches of the clitoris. The *transversus perinei muscle* is but very imperfectly developed, and often joined to the sphincter.

§ 248. The superficial branch of the *pudic artery* arises, in general, near the tuber ischii, gives off branches to muscles which are attached to this eminence, to the sphincter and transversus perinei, then dips down into the substance of the greater lip, and terminates on the mons Veneris. The deep branch of the same vessel rests against the internal surface of the ramus of the ischium, and passes obliquely forwards, upwards, and inwards, then proceeds behind the transversus perinei, where it gives off a small branch, which goes into the recto-vaginal septum, and is then situated in front of the ramus of the pubes, beneath the clitoris and its erector muscle. The size of this vessel, and of its branches, is so small, especially in the neighbourhood of the pubes, that their division would not cause any serious hæmorrhage. The *perineal aponeurosis*, between the layers of which these vessels are lodged, do not present any thing remarkable; which is also the case with the levator ani and ischio-coccygeus muscles.

§ 249. The *canal of the urethra*, the length of which is about twelve or thirteen lines only, describes a slight curve, the convexity of which is turned upwards. Anteriorly, it is separated from the symphysis of the pubes and the clitoris by very elastic cellular tissue. Posteriorly, it adheres to the parietes of the vagina, at which spot there is a kind of longitudinal projection.

The diameter of the urethra in the female is much larger than in the male, and may be more easily dilated. The structure of the canal is nearly the same as that in man; it consists of a mucous membrane, surrounded by a thin layer of spongy tissue; but there is no body whatever analogous to the prostate. The *neck of the bladder*, which is shorter than in man, rests immediately on the vagina and the levator ani; anteriorly, it is only separated from the symphysis of the pubis by the anterior ligaments of the bladder, and by cellular tissue. In general this membranous viscus rises higher above the pubes than in the male; hence the high operation for stone is much easier. From the anatomical details which we have given, it will be seen that opening the bladder between the pubes and the urethra, without wounding this canal, is an easy operation. A semilunar incision is first made in front of the meatus urinarius, which is previously depressed by a sound introduced into the bladder; and in this way, 1, the mucous membrane; 2, the subcutaneous cellular tissue; 3, the constrictor muscle of the vagina, and the perineal aponeurosis; 4, some elastic cellular tissue, are divided. After this the operator arrives at the anterior and inferior surface of the bladder, which he opens transversely, care being taken not to detach it from the posterior surface of the pubes. This mode of operating is preferable to that of M. Dubois, in which the urethra is divided as far as the symphysis of the pubes; for this division of the urethra is often followed by incontinence of urine.

§ 250. The vagina is a canal about six inches in length, and an inch broad, extending obliquely from below upwards, and from before backwards, from the vulva as far as the neck of the womb. Its anterior surface, which is slightly concave, is directed upwards, adheres very closely to the urethra, and is connected to the bladder by loose cellular tissue. The bladder might be opened in this way; but the operation would be almost always followed by an incurable fistula. The vagina very frequently folds on the lateral parts of the urethra, so that it is very difficult to avoid it in opening this canal according to the plan of M. Louis. The pos-

terior surface of the vagina is inferiorly united to the rectum by serrated cellular tissue; superiorly, it is separated from this intestine by the peritoneum. The sides of the vagina are surrounded by a great quantity of cellular tissue, and correspond to the ureters, to the plexus formed by the vessels of the womb and of the vagina, and inferiorly, to the levatores ani. The parietes of the vagina examined internally present a great number of mucous lacunæ and folds; near the neck of the womb they are not very distinct; at the lower half of the canal, they extend transversely from the sides of the vulva. During delivery they completely disappear, and the diameter of the vagina equals in size the head of the child. Lastly, its superior extremity completely embraces the neck of the womb.

§ 251. In the natural state, the *uterus* occupies the middle part of the smaller pelvis, and is situated behind the bladder, in front of the rectum, and below the convolutions of the ilium, and does not rise as far as the superior edge of the pubes. The peritoneum covers this organ, and forms on each side a vertical fold, which contains some cellular tissue, the fallopian tube, round ligament, and ovary. These folds, which are called *broad ligaments of the uterus*, form, with this viscus and the upper part of the vagina, a kind of transverse septum, which divides the cavity of the pelvis into two parts, the anterior of which lodges the bladder; the posterior, the rectum. The *round ligaments* are fibro-vascular cords, which arise from the lateral superior and anterior portions of the uterus, below, and in front of the fallopian tubes; they proceed first outwards, then upwards, above the iliac vessels, towards the inguinal ring, to be distributed to the cellular tissue of the mons Veneris. These ligaments are so arranged that the womb enjoys a certain degree of motion. But the bands which fix it to the parietes of the pelvis, may be relaxed to such a degree as to allow the uterus to descend into the vagina, sometimes even beyond the vulva, and between the thighs. In the natural state it is placed obliquely from above downwards and behind forwards. Hence, its retroversion is more common than its anteversion. In these cases, it is evident that

the pressure exercised by the small intestines on the anterior surface of the womb, must tend to increase this displacement, and that the bladder, from its intimate connexion with the lower extremity of the uterus, will, during its dilatation, draw the womb along with it.

In the unimpregnated state the womb is pyriform, and flattened from before backwards. It is about an inch thick, two inches and a half in depth, and from an inch and a half to two inches broad at its superior, and ten lines at its lower part. The womb may be divided into two portions, the inferior of which is long and narrow, and called its neck, and the superior which is larger, and called the body of the womb. This last portion is about two inches in length, its form is nearly oval. The anterior is not so convex as its posterior surface; and its superior edge, which is round and convex, forms, at its union with the lateral edges, two angles, to which the fallopian tubes are attached. The neck of the womb is cylindroid, slightly enlarged in its centre, and compressed from before backwards; it is almost insensibly continuous with the body of this organ. It is from ten to twelve lines long, and six to eight thick. Its inferior extremity projects into the vagina, and has an oval aperture which communicates with the cavity of the womb. This fissure is always open to a certain extent, and is situated transversely, being bounded by two rounded lips, one of which is situated anteriorly, and is thicker than the other.

During pregnancy, the form, size, and situation of the uterus undergo considerable changes. Its parietes increase in thickness, the pyriform shape of the organ not being at all changed; its fundus and the superior part of the neck enlarge, whilst its orifice becomes contracted and round. The inferior part of the body soon assumes a spheroidal form, the neck becomes hollowed and forms a kind of appendix to it. Towards the sixth month of pregnancy the neck becomes more hollowed, and the whole womb assumes an ovoid shape, the greater extremity of which is turned upwards. The length of the cylindrical portion gradually diminishes, and towards the end of pregnancy, the lips of the external opening project. At this period, the size of the

womb is so much increased that its longitudinal diameter is about twelve, the transverse nine, and the antero-posterior eight inches and a half. At the commencement of pregnancy, the uterus descends into the pelvis by the force of its size and weight; its posterior surface is most rapidly developed; and hence, it is pushed forwards by the sacro-vertebral angle, so that it descends, the os uteri being carried backwards. Between the third and fourth month, the uterus becomes too large for the pelvis, and ascends in the abdomen; at this time it is pushed forwards by the lumbar vertebræ, and is inclined a little to one side. The fundus of the uterus is then directed forwards; towards the fourth month it may be felt above the pubes; at five months it ascends one or two inches from the umbilicus; at seven months, it occupies the inferior portion of the epigastric region; and lastly, at the eighth month it approaches to the ensiform cartilage.

§ 252. The *rectum* is connected anteriorly with the womb and vagina; inferiorly, it is united to this canal by cellular tissue and a net-work of vessels; superiorly, it is separated from the organs of generation by a fold of peritoneum, which forms a kind of cul-de-sac, into which the intestines sometimes make their escape. In the cases of vaginal hernia, the viscera generally pass between the rectum and the uterus, carrying before them a process of peritoneum. Before the intestines can reach the greater labia, they must traverse the pelvic aponeurosis, and the levator ani near its opening on the sides of the vagina. The tumour is then situated on the inner side of the internal pudic, and outer side of the vaginal arteries; this last vessel is a small branch from the internal iliac, and descends on the sides of the vagina.

§ 253. The bony frame-work of the *pelvis* is formed by the sacrum and coccyx posteriorly, and by the ossa innominata anteriorly and laterally; its form is nearly conoid, being compressed from before to behind, and obliquely divided on its two extremities. Its external surface is very narrow anteriorly, and presents on the median line the *symphysis pubis;* this articulation is formed by two oval surfaces, a dense fibro-cartilagi-

nous layer, and by the anterior and posterior pubic ligaments. In the common state, it does not allow of any motion; but, in general, towards the end of pregnancy, the ligaments which join these bones are slightly relaxed, from which circumstance these parts acquire a certain degree of motion, and become susceptible of some degree of separation, thus increasing the lateral diameter of the pelvis. It is to produce an effect of this kind, but of much greater extent, that recourse has been had to the operation of synchondrotomy, by which means a separation of about an inch is obtained, which increases the oblique diameter of the pelvis about three lines. This operation is very simple, for it is only necessary to divide the integuments of the mons Veneris vertically, and to cut away the inter-articular cartilage; care must be taken not to carry the instrument too deep, for fear of wounding the bladder, or even the uterus; and not to separate these bones too much, for they might be disarticulated from their connexion with the sacrum.

On each side of the symphysis pubis, a slightly concave surface is situated, which gives attachment to the adductors of the thigh and obturator externus, and a very large opening, called the *obturator*, or *sub-pubic foramen;* it is oval in man, in women it is smaller, and triangular; its great diameter is inclined downwards and outwards. Its circumference, thin and irregular, gives attachment to a fibrous membrane, which completely closes it, excepting superiorly, where a sulcus is situated, directed obliquely from behind forwards, and from without inwards, which gives passage to the obturator vessels and nerves. The horizontal and narrow portion of the pubis, situated above the obturator foramen, is called the body of the bone; the vertical portion is larger, and forms the ramus of the pubes. On the lateral parts of the pelvis, we observe a large surface, directed outwards, backwards, and downwards; it is the external iliac fossa, situated above the cotyloid cavity, which receives the head of the femur, of which we shall speak in the following chapter. The posterior surface of the sacrum, convex from above downwards, presents a great number of bony projections, and is

only covered by integument, subcutaneous cellular tissue, and aponeuroses. The articulation of these bones with the coccyx is strengthened by an interosseus fibro-cartilage, and by a very strong ligament, situated posteriorly. The different pieces of the coccyx are articulated in the same manner; hence, they allow of slight motion, which, however, only takes place from the impulse of some external force. Dislocations of this bone are never complete, and, in general, the parts resume their natural situation as soon as the cause of the displacement is removed. The sacrum is articulated to the iliac bones by a large rough surface, which is narrower above than below, and directed obliquely backwards and outwards. From the direction of these articular surfaces, it will be seen that the sacrum, which is a continuation of the vertebral column, and which consequently supports the greatest part of the weight of the body, must always tend to separate the two iliac bones, between which it is placed as a wedge. Hence, almost all the ligaments which surround the sacro-iliac symphysis are arranged so as to oppose this kind of displacement, and their resistance is so great, that in the natural state the action of a very considerable power is necessary to produce these accidents. There are some instances of the sacrum being dislocated forwards, and the ilium upwards and forwards, but they are very rare. When the pubis is fractured, or after the operation of synchondrotomy, a slight cause, on the contrary, is sufficient to produce these accidents, for the anterior surface of the articulation is only covered by some whitish fibres.

§ 254. An exact knowledge of the interior of the pelvis is much more important than that of the exterior of this bony cavity. The lateral and superior portion of the ilium constitutes a large and superficial fossa, which is filled by the iliacus muscle, and is, consequently, called the iliac fossa. This portion of the pelvis is separated from the pelvic cavity or the lesser pelvis by a round and prominent line, which constitutes the *superior aperture of the pelvis*, and which proceeds from the sacro-vertebral angle, or articulation of the sacrum with the last lumbar vertebræ, anteriorly and

inferiorly to the superior edge of the pubis. The antero-posterior diameter of the upper aperture of the pelvis, measured from the superior edge of the sacrum to the inner surface of the symphysis pubis, is about four inches in the female, and three in the male. The transverse diameter is five inches two lines; its oblique, taken from the sacro-iliac articulation of one side to the wall of the cotyloid cavity on the other, is four inches six lines. Lastly, its circumference is fourteen inches. In the recent subject, the psoas and iliacus muscles, and the iliac vessels and nerves placed on the side of the superior aperture, diminish its transverse diameter, so that its form becomes almost circular, instead of elliptical.

The lesser pelvis is little larger than the superior aperture; it represents a kind of curved canal, enlarged in the centre. Its anterior wall, which is concave, and directed upwards, presents in the middle the symphysis pubis, the inter-articular cartilage of which forms in general a kind of projecting ridge. On each side there is a plane surface, formed by the body of the pubes, then the obturator foramen, which is filled by the obturator ligaments and the obturator internus muscle. The posterior wall of the pelvis is formed by the sacrum and coccyx, and is concave from above downwards. The former of these bones is perforated by two rows of foramina, which communicate with the sacral canal and the posterior sacral foramina, and give passage to the anterior branches of the sacral nerves. On the outer side of these foramina, there is a surface, which gives attachment to the pyriform muscle. The lateral parietes of the pelvis present two very distinct portions; the one formed by the portion of the ilium corresponding to the cotyloid cavity, by the body and tuberosity of the ischium, is directed obliquely from above downwards, without inwards, and before backwards. The posterior portion is oblique, in a different direction, and is formed by the upper edge of the great sciatic notch and the sciatic ligament. (§ 226.) The space which exists in this spot is filled by the pyriform muscle.

§ 255. The *inferior aperture of the pelvis*, or perineal

circumference of this cavity, is formed by the pubes, the rami of the pubes and ischia, the great sacro-sciatic ligament, and the extremities of the sacrum and coccyx. Its shape is in general oval, and its great extremity is turned backwards; we observe on it three notches. The anterior, the sides of which are turned outwards, is bounded posteriorly by the tuberosities of the ischia, and is called the pubic arch. The space which separates these bony projections, and which forms the transverse diameter of the lower aperture, is four inches in extent; that from the symphysis of the pubis to the point of the coccyx is the same, but it may be increased half an inch, as when the coccyx is carried backwards during parturition.

The direction of the axis of the pelvis varies according to the position of the body, but it is never the same as that of the abdominal cavity. In this position the plane of the superior aperture forms an angle of about 35°, with a horizontal line drawn on the superior part of the symphysis of the pubes. A vertical line drawn from the third lumbar vertebra would fall very near to the superior edge of this articulation. The axis of this aperture corresponds to a line drawn from the umbilicus to the lower third of the sacrum; and lastly, the axis of the lower aperture crosses that of the superior towards the middle of the pelvis, and proceeds from the sacro-vertebral angle to the centre of the space comprised between the tuberosities of the ischia.

CHAPTER XV.

REGION OF THE HIP, OR COXO-FEMORAL REGION.

§ 256. We shall comprise in this division of the body the parts which cover the external surface of the lateral portion of the hip, and those which constitute the superior five-sixths of the thigh. It will be bounded, then, superiorly by the anterior region of the abdomen and

by the pelvis, and inferiorly by a line drawn around the thigh, about two inches below the condyles of the femur. The superior part of this region is called the buttock, and forms, at the posterior part of the pelvis, a considerable projection, depending on the great development of the muscles which extend the thigh and pelvis on each other, and which principally act in standing. It is bounded superiorly by the crista ilii; inferiorly, by a fold which separates it from the thigh; and internally, by the sacrum and anal portion of the pelvis. Externally, it is continuous with the hip, at the external part of which a projection, formed by the great trochanter, is situated. The thigh, or that portion of the lower extremity situated between the hip and knee, is bounded superiorly and internally by the perineum; superiorly and anteriorly, by the fold of the groin; and superiorly and posteriorly, by the fold which marks the inferior edge of the gluteus maximus. Its form is nearly conical, and its surface, generally rounded, presents elevations and depressions, which depend on the arrangement of the muscles, and which vary according to the position of the limb.

§ 257. The integuments of the thigh, thinner than those of the posterior part of the trunk, increase in fineness and elasticity towards the anal region. The skin of the thigh does not present any thing remarkable, excepting that it is thinner, whiter, and softer at the internal part of the limb than elsewhere. The subcutaneous cellular tissue of the thigh incloses, in general, a great quantity of adipose tissue, and is traversed by white filaments. This arrangement, which is very distinct below the tuber ischii, gives firmness and great elasticity to this kind of cellular fatty cushion which supports the whole weight of the body in the sitting position. At the anterior part of the thigh, the sub-cutaneous cellular layer presents the same characters as in the groin; it is lamellated, rather yielding, and firmly unites the skin to the subjacent aponeurosis. At the posterior part of the limb it is much thicker, looser, and more fatty, and is continuous with that of the nates. Lastly, it lodges no important vessel or nerve, except

at the internal and anterior part of the limb, where the vena saphæna interna is situated.

§ 258. The *fascia-lata* forms a sheath, which is continuous with that of the leg, and surrounds the whole of the lower extremity. We have already seen how it is connected to Poupart's ligament; superiorly and externally it is attached to the outer lip of the crista ilii; but, on the nates, it degenerates into two thin and cellular folds which cover the two surfaces of the gluteus maximus, and unite behind this muscle, to be attached to the great sacro-sciatic ligament, where they appear to be continuous with the perineal aponeurosis. Superiorly and internally, the crural aponeurosis is attached to the ligaments of the symphysis pubis, to that bone and the ischium. This fibrous sheath is one of the strongest aponeuroses which cover the human body. Hence, the details which we gave, when treating of the brachial aponeurosis, are, à fortiori, applicable to it. It is thickest at the outer part of the thigh; its external surface gives origin to a great number of layers and filaments which surround the superficial vessels, and are united to the integuments. Hence, in the circular amputation of the thigh, after the skin and sub-cutaneous cellular tissue have been divided, the surgeon must take care to cut these fibrous bands, in order to retract the parts sufficiently to allow of the division of the muscle. The internal surface of the crural aponeurosis is only united to the subjacent muscles by very loose cellular tissue; but it gives off to the muscles processes which completely envelope them. At the posterior part of the thigh it sends a layer to be attached to the linea-aspera of the femur: this kind of intermuscular aponeurosis forms a vertical septum between the extensors of the leg and the short portion of the biceps, the fibres of which muscle are inserted into it.

§ 259. The *glutæus maximus* is a very large, thick, and quadrilateral muscle; its fibres proceed obliquely from above downwards, from within outwards, and from behind forwards, and are attached superiorly to the crista and superior part of the external surface of the ilium, to the posterior sacro-iliac ligament, to the back part of the sacrum, to the coccyx and posterior

sacro-sciatic ligament. Inferiorly, this muscle terminates by a large tendon, which is continuous externally with the crural aponeurosis, and is inserted to the extent of about three inches into a rough ridge, which extends from the base of the great trochanter to the linea-aspera of the femur, between the adductor magnus and vastus internus muscles. The bundles formed by these fleshy fibres are very distinct, and lodge between them a considerable quantity of cellular tissue. Hence, in cases of superficial inflammation of this part, it will be seen that the pus makes its way between the fibres of the muscle. The anterior surface of the glutæus maximus is in relation with the ilium, sacrum, coccyx, origin of the sacro-spinalis, glutæus medius, pyriformis, gemelli, the obturator internus, quadratus femoris, sciatic nerve, tuber ischii, the posterior sacro-sciatic ligament, the superior extremity of the biceps, the semi-tendinosus, adductor magnus, and vastus internus; and it rests on the great trochanter, from which it is separated by a synovial bursa.

§ 260. *The glutæus medius*, covered in its posterior half by the former muscle, and in the remainder of its extent by the crural aponeurosis, is large and triangular. It is attached to a kind of aponeurotic arch which passes along the linea semilunaris of the ilium, to the anterior part of the crista of the same bone, and to the crural aponeurosis, and also to the superior edge of the great trochanter. The *glutæus minimus*, situated below the former muscle, is attached lower down to the external surface of the ilium, and terminates inferiorly in a large aponeurosis, which is converted into a thick tendon, and is attached to the great trochanter. The *pyriformis* partly covers the posterior border of the glutæus minimus, after having passed from the pelvis by the sciatic notch, and joining the gemellus superior, its terminating tendon is attached to the digital cavity of the great trochanter. The *gluteal artery* passes between the pyriformis and glutæus minimus: this vessel, which we have described as arising from the internal iliac, reaches the upper part of the sciatic notch. It is then covered by the glutæus maximus, and divides into a superficial and deep branch: the former ramifies

between the glutæi maximus and medius; the latter ascends from behind forwards beneath this last muscle, and forms an arch along the convex edge of the glutæus minimus. The deep situation of this artery has led some to suppose that aneurisms of this vessel cannot be cured; but cases are related, in which the operation of tying the internal iliac artery has been successfully performed.

§ 261. *The gemelli* are attached to the spine and tuberosity of the ischium, and to the internal surface of the great trochanter. The tendon of the obturator internus passes between these two muscles, to reach the great trochanter. The gemelli are covered posteriorly by the glutæus maximus and sciatic nerve. The *quadratus femoris* is also covered by the same parts; it is inserted on the outer side of the tuber ischii and lower edge of the back part of the great trochanter. Lastly, the *obturator externus* is situated at the upper and inner part of the thigh, and is covered anteriorly by the quadratus, the adductors and pectineus. It is in relation posteriorly with the ilium, the obturator ligament, and coxo-femoral articulation, and is attached to the obturator fossa and the digital cavity of the great trochanter.

§ 262. *The sciatic nerve* leaves the pelvis, as we have before said, by the sciatic notch, between the pyriformis and gemelli. It then descends a little obliquely outwards towards the ham, and rests on the gemelli, the tendon of the obturator, the quadratus femoris, and *adductor magnus.* This last muscle, of a triangular shape, and very large, occupies almost all the internal and posterior parts of the thigh, and is attached to the tuberosity and ramus of the ischium, to the linea aspera and ridge which unites it to the great trochanter; inferiorly, its tendon divides, to allow of the passage of the crural vessels. During its course the sciatic nerve is covered posteriorly by the glutæus maximus, biceps, and semi-tendinosus. The biceps is composed of two portions superiorly, but towards its termination one only is situated at the posterior and external parts of the thigh. Its long head is attached to the tuberosity of the ischium by a tendon common to it and the

semi-tendinosus; the short portion, flattened and quadrilateral, is inserted into the outer crista of the linea aspera of the femur, between the adductor magnus and vasti muscles, from which it is separated by a layer of the crural aponeurosis. (§ 258.) After the two portions of the biceps are united, they go to be inserted into the head of the fibula. The *semi-tendinosus*, small and tendinous superiorly, thin and fleshy inferiorly, is a long muscle extending obliquely from the tuberosity of the ischium to the inner side of the knee-joint. Its posterior surface is covered by the glutæus maximus and the crural aponeurosis; the anterior rests on the *semi-membranosus* and the adductor magnus. The former of these muscles, thin and tendinous superiorly, and thick and fleshy in its two lower thirds, is attached by one extremity to the tuberosity of the ischium, between the quadratus and biceps; the other to the internal tuberosity of the tibia. The sciatic nerve proceeds along its outer edge, and follows the direction of a line drawn from the centre of the popliteal space to midway between the tuberosity of the ischium and the trochanter major. It is one of the longest and largest nerves of the body, and one of those most frequently the seat of neuralgic pains. The *ischiatic artery*, a branch from the internal iliac, leaves the pelvis by the inferior part of the sciatic notch, between the pyriform muscle and the anterior sacro-sciatic ligament, or the inner side of the sciatic nerve; it divides into several branches, the greater part of which are distributed to the muscles of the nates; but one, which appears to be the continuation of the trunk, accompanies the sciatic nerve to the inferior and posterior part of the thigh. In amputation of the thigh, it frequently requires to be tied.

§ 263. On the anterior surface of the limb, the *sartorius* presents itself to our view, immediately the crural aponeurosis is raised. It is attached to the anterior superior spine of the ilium, and is lodged in a kind of fibrous sheath formed by the aponeurosis of the thigh. It is a long thin muscle, and proceeds obliquely inwards and backwards to the internal surface of the knee. Lastly, its fibres, which are of a considerable length

and parallel to each other, are only united to the neighbouring parts by very loose cellular tissue; hence, when the muscle is divided, its extremities retract to a considerable extent. The *rectus femoris*, covered in part by the fascia lata, and in part by the sartorius, extends vertically on the anterior surface of the thigh, and is attached superiorly to the anterior inferior spinous process of the ilium; and inferiorly to the patella, by a tendon which is common to it and the three extensors of the leg.

§ 264. The *crural artery* is a continuation of the external iliac, and assumes this name when it reaches beneath the crural arch. (Vide § 198.) Taking a course obliquely downwards and inwards, it is situated between the inner edge of the sartorius and the anterior surface of the adductor brevis; but about four inches below Poupart's ligament, the sartorius crosses it. In this part of its course the crural nerve is situated to the outer side of the artery, and the vein to the inner side. The artery and vein are inclosed in a sheath formed by the deep layer of the crural aponeurosis. Some lymphatic glands and a considerable quantity of fatty cellular tissue separate the artery from the anterior layer of the aponeurosis of the fascia lata and the integuments; the pulsations, however, of this vessel, may generally be felt by putting the finger into a triangular depression situated at the superior, anterior, and internal part of the thigh. Posteriorly, this vessel rests on the pectineus, adductores longus and brevis, from which it is separated by a thick layer of fat. Externally, it is in relation with the tendons of the psoas and iliacus muscles, and internally, with the pectineus. After passing beneath the sartorius, the crural artery turns backwards, and towards the lower third of the thigh (about five inches above the inner condyle of the femur) passes between the two bundles which terminate inferiorly the adductor magnus. The aponeurotic sheath which surrounds it becomes considerably thicker towards this point, and is strengthened by processes which extend from the extensors of the leg to the adductors; hence, aneurisms, situated at the upper, acquire a much larger size in the same time than those

at the lower part of the thigh. When the artery has passed through the tendon of the adductor magnus, and reached the posterior surface of the thigh, it assumes the name of popliteal. The principal branches from this vessel are given off towards its upper part; the first is, in general, a subcutaneous branch, which ascends obliquely outwards between the abdominal aponeurosis and the integuments. The external pudics are also given off from the crural, very near Poupart's ligament; they proceed transversely inwards, the one between the skin and the fascia lata, the other beneath this aponeurosis, and go to be distributed to the organs of generation. The arteria profunda arises from the posterior part of the crural, about an inch and a half or two inches from the arch. It descends obliquely backwards as far as the superior attachment of the cruræus, then turns inwards, and passes between the femur and the adductor brevis and medius. If an aneurism of the crural artery occurs at a small distance above the origin of the profunda, M. Boyer advises the performance of the operation according to the old method, in order to avoid the obliteration of this vessel. But, according to M. Marjolin, it is better to tie the external iliac. When tumours of this nature are developed in the middle or inferior part of the thigh, the crural artery itself must be tied. Hunter's mode of performing this operation consists in making an incision on the anterior and internal part of the thigh a little below its centre, so as to secure the artery near the spot where it traverses the adductor muscle. But since Hunter's time most surgeons apply the ligature higher up, on account of the more superficial situation of the artery, and its greater distance from the seat of aneurism; which render the operation more easy of performance, and the chance of success greater. On the other hand, the ligature must never be placed less than an inch below the origin of the profunda; for the closeness of this vessel would prevent the blood from coagulating to a sufficient extent above the obliterated point, and the risk of hæmorrhage would be incurred when the ligature came away. If the size of the tumour should not admit of the application of a ligature

at this distance, it is much better at once to tie the external iliac. The most convenient point for tying the femoral artery is about four or five inches below Poupart's ligament. Hodgson recommends the incision to be made along the inner edge of the sartorius muscle, commencing two inches and a half from Poupart's ligament, and extending it from three to four inches. The sartorius is then carried to the outer side, when the pulsation of the artery may be felt with the finger; the aponeurosis which covers it is then divided, and after the artery has been exposed a ligature is put round it. In general, the branches of the crural nerve, which accompany the artery, are situated to its outer side nearer the femur, and are separated from it by dense cellular tissue; hence, it is sufficient, in most cases, to keep the needle close to the artery, in order to avoid including the nerves. Sometimes a small branch passes down in front of the artery. The same precautions are necessary for the purpose of avoiding the crural vein, which is situated immediately beneath the artery. Some surgeons dread wounding in this operation the saphæna interna, which ascends along the anterior and internal part of the thigh between the integuments and the crural aponeurosis, and they have consequently advised the incision to be made along the outer edge of the sartorius; then this muscle must be carried a little upwards and inwards to get at the artery. But this precaution is, in general, useless; and, moreover, the operator would be obliged to apply the ligature too near the seat of the complaint, and in a spot where the artery is deeply situated.

From the oblique course of the crural artery, it is evident that the spot where this vessel is to be met with after circular amputation of the thigh, must vary according to the height at which the operation is performed. Hence, when the limb is amputated on a level with the aponeurotic arch of the third adductor, it will be situated on the inner side of the stump, whilst it will be placed anteriorly and internally when the operation is performed higher up, and posteriorly if lower down.

§ 265. The crural vein follows exactly the same

course as the artery; towards the lower part of the thigh it is situated behind this vessel, but in the upper part it is on the inner side. Near the crural arch it receives the saphæna interna, and is continued under the name of external iliac vein. The *crural nerve* arises from the lumbar plexus, descends in front of the iliacus muscle, leaves the abdomen behind the crural arch, and divides immediately afterwards into a considerable number of branches; one of these descends at first to the inner side of the artery, beneath the sartorius, and on the inner side of the knee, where it becomes superficial, to accompany the saphæna interna; another, but a smaller branch, accompanies the crural artery.

§ 266. The mass of muscles situated beneath the crural vessels is formed by the pectineus, adductors, two vasti, and cruræus. The first, of a triangular shape, is placed at the upper and anterior part of the thigh. It is attached by its base to the superior edge of the pubes, descends obliquely outwards and backwards, and is inserted into the crista, which extends from the trochanter minor to the linea aspera. There are three adductor muscles; the first, or *middle adductor*, situated in front of the two others, at the internal and superior part of the thigh, is attached superiorly to the body of the pubes, and terminates inferiorly by an aponeurosis, which is inserted into the linea aspera to the extent of three inches between the vastus internus and adductor magnus. The second, or *adductor brevis*, placed in front of the former, is attached in part to the bony surface which is situated between the symphysis of the pubes and the obturator foramen, and in part to the linea aspera below the trochanter minor, where it is continuous with the pectineus, adductores longus and magnus. The *gracilis* partly covers the adductors and the semi-membranosus; it is a thin, long, fleshy bundle, which is attached to the pubes and to the ramus of the ischium, and descends vertically on the internal part of the thigh, to terminate on the inner and superior part of the tibia. Its outer surface is covered by the crural aponeurosis and sartorius.

The triceps cruralis,* which rests immediately on the femur, is very large, and is divided superiorly into three distinct portions. The outer one, which is the largest, is attached to the great trochanter, to the crista extending from this process to the linea aspera, to the outer ridge of this line, the aponeurosis which separates it from the short portion of the biceps, and lastly, to the outer surface of the femur. The internal portion is attached to the base of the lesser trochanter, to the internal lip of the linea aspera, and internal surface of the femur. Lastly, the central part, which is the smallest, is frequently united with the internal, and is fixed to the anterior part of the neck of the femur, the oblique crista which extends from the great to the lesser trochanter, and the three superior fourths of the anterior surface of the femur. These three fleshy portions, after being united by means of large aponeuroses, terminate in a tendon which joins that of the rectus femoris, and is attached to the patella. The outer surface of this muscle is in relation with the tendons of the glutæi maximus and minimus, the crural aponeurosis, and the short portion of the biceps. In the middle it is connected with the iliacus, rectus femoris, and external circumflex arteries, and internally with the common aponeurosis, crural artery, and sartorius; its posterior surface covers the whole superficies of the body of the femur.

§ 267. The arteria profunda, the origin of which we have already given, passes between the femur and the adductores brevis and medius, and after it reaches the posterior surface of the thigh it divides into two branches, which are distributed to the short portion of the biceps and the semi-membranosus. At the anterior and superior part of the thigh, this vessel forms a curve, from which it sends a branch transversely outwards behind the sartorius and rectus, called the *external circumflex*. This artery soon divides into two branches, one of which turns upwards on the femur, and terminates near the hip; the other, much larger, descends along the anterior part of the thigh, between the rec-

* The triceps cruralis includes the two vasti and the cruræus.

tus and cruræus. The *internal circumflex*, larger than the external, arises from the profunda near to its origin, and then dips down between the pectineus and the tendons of the psoas and iliacus muscles. It then turns round the internal part of the neck of the femur, and accompanies the obturator externus beneath the adductor magnus and brevis. Lastly, behind the neck of the femur it divides into two branches, an ascending and transverse. It is for the purpose of stopping the course of the blood in all the vessels, that in amputation of the thigh at the joint, according to M. Larrey, the femoral artery must be first tied above the origin of the profunda, and as near as possible to the crural arch.

§ 268. The bones of this part of the body consist of the femur and the ilium, of which we have already had occasion to speak (vid. § 199 and § 253.)

The femur, like all long bones, may be divided into a body and two extremities. It is slightly curved forwards, and directed obliquely from above downwards, and from without inwards, so that its upper is much farther separated from the bone of the opposite side than its lower extremity. The body of this bone, thinner in its centre than towards its extremities, presents three well-defined surfaces superiorly, which towards the lower part become joined into one. The anterior, convex and rather large, is covered by the two vasti and cruræus, the fibres of which are attached to its superior three-fourths. The external surface, narrow, slightly concave superiorly, and convex inferiorly, is in relation with the same muscles. The internal surface is almost plane, and separated from the external by a rough vertical ridge: this is the linea aspera of the femur which gives attachment to the triceps cruralis and short portion of the biceps, internally to the former of these muscles, and at its centre to the three adductors, and to a prolongation of the crural aponeurosis. In amputation of the thigh, the attachment of these muscles must be divided to a certain extent, to allow of their retracting as much as those situated more superficially.

Fractures of the femur generally take place in the centre of this bone, for it is in this spot that its dia-

meter is the least, and its curvature the greatest; its great length, its thinness, when compared with the thigh, and the power and number of the muscles which surround it, are circumstances which render the displacement of the ends of the bone inevitable. In cases of this kind, at least whenever the fracture does not take place above or immediately below the trochanters, it is always the inferior end which is displaced. If the solution of continuity is transverse, and situated near the centre of the thigh, the adductors, and all the flexors of the leg, viz. the semi-tendinosus, the semi-membranosus, the biceps, and gracilis, tend to curve the femur backwards, and cause a projecting angle anteriorly: as soon as the ends no longer touch each other, the lower one, into the whole length of which the adductors are inserted, is drawn inwards, whilst its lower part projects on the outer side. The combined action of all the muscles, which are attached above and below the fracture, causes, at the same time, shortening of the limb. When the fracture is oblique, the lower is consequently drawn above and to the inner side of the upper end.

§ 269. The superior extremity of the femur is of a very irregular form, and presents three large eminences, viz., the head, the great and *small trochanter.* This last process, the smallest of the three, is situated posteriorly, and of a pyramidal form; its apex, directed inwards and backwards, gives attachment to the tendons of the psoas and iliacus muscles; its base is triangular, and is divided into three lines, the inferior of which joins the linea aspera, the superior and external goes to the trochanter major; and the superior and internal passes on the oblique surface of the cervix of the femur. When this bone is fractured immediately below the lesser trochanter, the superior extremity of the femur is drawn forwards by the action of these muscles, and forms a projection in the fold of the groin.

§ 270. The *trochanter major* occupies the outer part of the upper extremity of the femur; it is a quadrilateral projection, thick and rough, giving attachment at its top to the tendon of the gluteus medius. Exter-

nally, it is large and convex, and separated from the gluteus maximus by a synovial bursa; internally, it is intersected by a digital cavity, which serves for the insertion of the tendons of the pyriformis, the gemelli, and obturatores. Anteriorly, it is very large, and gives attachment to the gluteus minimus; lastly, the quadratus femoris is attached to its posterior surface, which is round and narrow, but more marked than its anterior. The trochanter major may be fractured at its base, and separated from the rest of the bone; by the contraction of the gluteus maximus, it will be carried upwards and backwards. In all cases of fracture of the femur, it is very difficult to keep the ends of the bone in their natural relations, on account of the great number of powerful muscles which surround it. But it is especially when the solution of continuity is situated near the trochanters, that the difficulty of keeping the ends of the bones opposed to each other is the greatest. For then, the bandages which are applied on the fractured limbs scarcely act on the upper end, and nothing hinders its being carried forwards and following the motions of the trunk.

§ 271. The *head of the femur*, the largest and most elevated of the three processes of the upper extremity of this bone, is of a nearly spherical form, and directed obliquely upwards, inwards, and a little forwards. It is surrounded by cartilages, to be articulated with the acetabulum, and sustained by an elongated neck, the axis of which forms, with that of the rest of the bone, an obtuse and projecting angle externally. Hence it happens, that the weight of the body is not transmitted to the lower extremity, according to the direction of the action of the femur, but always tends to increase the obliquity of this bone. In cases, therefore, of a sudden fall on the feet or knees, this part of the bone is often fractured. In general, however, cases of this kind are caused by falls on the trochanter major; then this process, sustaining the whole weight of the body, powerfully pushes the head of the femur, in an oblique direction, against the acetabulum, and tends to destroy the angle which the neck of this bone forms with its central part. In this case, the mechanism of the frac-

ture is then entirely different from that which takes place in accidents of this kind produced by falls on the feet. All fractures situated above the two trochanters are called fractures of the neck of the femur. They may take place either above or below the spot where the capsular ligament is attached; this is marked by two large rough lines, which surround the base of the neck, near its junction with the rest of the bone. In the former case, the fracture is generally transverse, and the upper end of the bone being inclosed within the joint, only receives its blood from some arteries lodged in the substance of the ligamentum teres; this ligament is attached to the top of the head of the femur and to the bottom of the acetabulum. Hence it happens, that union of the fractured ends rarely, if ever, takes place, unless the fibrous expansion which surrounds the neck of the bone, and which serves the place of the periosteum, is not completely torn, as often happens. In cases of this kind, the shortening of the limb is very considerable, because the ligamentum teres, which is never torn, prevents the lower end from ascending. When the neck of the femur is fractured below the capsule, the solution of continuity is in general oblique, the trochanter major constituting a part of the upper end. The shortening of the limb is much more considerable, for nothing hinders the lower portion of the bone from obeying the muscles which draw it upwards, and all those which are attached to the pelvis on one hand, and to the body of the femur, or to the leg, on the other, from acting in the same manner. The limb is, at the same time, rotated outwards: its weight is sufficient to explain this, but the pyriformis, the gemelli, the obturatores, and quadratus, very powerfully contribute towards this position of the limb, the action of which is no longer counterbalanced by the resistance of the neck of the femur. Lastly, if the limb be moved inwards, it is evident that the femur will turn on its axis, and that the section of the circle described by the trochanter major is small, in proportion as the fracture is situated near the base of the neck.

§ 272. The portion of the external surface of the *ilium*, which now remains to be described, is formed

superiorly by the external iliac fossa. This large surface, irregularly concave and convex, is turned outwards, and traversed by two curved lines, which serve for the insertion of the glutei; it is bounded superiorly by the crista ilii; posteriorly, by the sacrum and sciatic notch; and inferiorly, by the *acetabulum* or *cotyloid cavity*. This articular cavity, nearly hemispherical, and directed obliquely outwards, forwards, and downwards, about two inches in diameter, is circumscribed upwards and outwards by a projecting ridge, excepting at its anterior part, where there is a groove for the passage of the vessels of the joint. A fibro-cartilaginous border, called the cotyloid ligament, is situated on the edge of this cavity, and increases its depth. On the inner side of this ligament, the notch which is situated at the anterior and inferior part of the circumference of the acetabulum gives attachment to two fibrous bundles, which constitute the ligamentum teres, pass upwards, inwards, and backwards, and, after uniting, are attached to a rough ridge, which is situated on the top of the head of the femur. Lastly, the capsular ligament, the power and extent of which are very considerable, surrounds the whole of the coxo-femoral articulation, and is partly attached to the circumference of the acetabulum and to the cotyloid ligament, and in part around the base of the neck of the femur. Hence, if, in amputation of the thigh at the joint, the operator divides this fibrous membrane around the cervix of the femur, great difficulty will be experienced in making the head of this bone escape from the acetabulum; if, on the contrary, the surgeon makes a circular incision around the head of the bone, the disarticulation is very easy, and the knife may, without obstacle, be carried to the bottom of the acetabulum, for the purpose of dividing the ligamentum teres.

The capsular ligament is thicker anteriorly and superiorly than elsewhere; for it is strengthened by a bundle of fibres, which descends from the anterior and inferior spinous process of the ilium, and by some fibres from the portion of the tendon of the rectus femoris, which is attached to the superior part of the edge of the acetabulum. Hence, the femur is very seldom dis-

located in this direction; when it does take place, the head of the bone passes on the horizontal ramus of the pubes, beneath the iliac and psoas muscles, and pushes the vessels and crural nerve inwards, without compressing them so as to produce any serious symptom. By this displacement, the limb must be shortened, and the pyriformis, gemelli, and obturator, being put on the stretch, must turn the knee and the point of the foot outwards. The capsular ligament is thinnest inferiorly and anteriorly, and in this spot the notch of the edge of the acetabulum is situated. Hence, it has been supposed that the femur would be most frequently dislocated in this direction. This opinion appears the more probable, as the ligamentum teres cannot offer any resistance to this kind of displacement, and the muscles situated at the inner part of the thigh are less capable of resisting any efforts which would tend to cause dislocation; and lastly, as the motion by which the thigh is separated from that of the opposite side is the most extensive of those which it executes. But experience has shown that the dislocation upwards and outwards is equally as common. In every case of dislocation of the head of the femur, the capsular ligament is torn; when the dislocation has taken place upwards and outwards, the head of the bone glides between the gluteus minimus and external surface of the ilium, and all the muscles of the thigh are placed in a state of relaxation, excepting the pyriformis, gemelli, obturatores, and quadratus. The limb is, consequently, shortened, and one would at first expect to find it rotated outwards, since the muscles of which we have been speaking act in this direction. But this is not the case, for the knee and point of the foot are always turned inwards, which appears to depend on the influence exercised by that portion of the capsular ligament which comes from the anterior inferior spinous process of the ilium. In the dislocation downwards and inwards, the head of the femur is lodged in the obturator foramen, and the adductor muscles are put on the stretch, thus forming a kind of cord, which extends from the pubes to the centre of the thigh. The glutei, pyriformis, gemelli, obturatores, and quadratus muscles are also put on the

stretch; hence, the knee and foot are turned outwards, and the great trochanter no longer projects, as in the natural state. Lastly, in dislocations downwards and backwards, the head of the femur is carried towards the ischiatic notch; but this kind of displacement is extremely rare, for it cannot take place unless the thigh were bent and at the same time carried inwards, more, indeed, than at first sight appears possible, from the resistance of the anterior part of the trunk, and the limb of the opposite side.

§ 273. The hip-joint is very deeply situated, and is surrounded by so large a mass of muscles, that it is often difficult to ascertain its precise spot, especially when the limb is swollen, and the patient complains of violent pain. Under such circumstances, the processes about the joint can be the only guide to the surgeon during the examination of the part. M. Lisfranc gives the following directions on this subject; 1st, if a line about an inch and a quarter in extent be drawn from the apex of the anterior superior spinous process, parallel to the axis of the limb, and another transverse line be drawn from the end of this, it will pass on the outer and anterior surface of the joint, about an inch and a half to the inner side of the former; 2d, a line half an inch in length, drawn parallel to the axis of the limb, from the anterior inferior spinous process of the ilium, will fall on the superior part of the joint; 3d, if a line two inches and a quarter long be drawn from the spine of the pubes, and directed transversely outwards, the joint will be found at a quarter of an inch below its extremity; 4th, lastly, if a right-angled triangle be drawn, one of the sides of which, about half an inch long, and parallel to the axis of the limb, terminates inferiorly on the fore and upper part of the great trochanter, and the other side, of an inch in length, be directed transversely inwards, the superior and internal angle will correspond to the outer side of the head of the femur. In the amputation at the hip-joint, according to M. Lisfranc's method, a most accurate knowledge of the situation of the joint is necessary. This surgeon introduces the knife in the spot corresponding to the anterior and superior part of the joint, penetrates

on the head of the femur, turns the surface of the knife, and brings the point out a few lines below the tuberosity of the ischium. He then prolongs the incision downwards, carries it round the trochanter major, down the femur, to the extent of two inches, and after having thus finished the outer flap, he ties the gluteal, ischiatic, and external circumflex arteries, which are comprised in it. He then forms the inner flap, carrying the knife round the inner surface of the femur, and cutting downwards and inwards, care being taken to avoid the trochanter minor. But before the incision is completed, an assistant introduces his fingers into the anterior and superior part of the wound, so as to compress the femoral artery and the profunda. Lastly, after all the vessels have been secured, the capsular ligament is then divided, and the head of the femur disarticulated.

CHAPTER XVI.

REGION OF THE KNEE AND LEG.

§ 274. We comprise in this division of the body that portion of the lower extremity situated between the circular line which we took for the inferior limit of the coxo-femoral region and a second circular line drawn immediately above the malleoli. The knee occupies its superior part; in front it forms a considerable projection, principally caused by the patella, the edges of which may be readily distinguished. The anterior part of the condyles of the femur may be also felt through the integuments, as well as the pulley which separates them, if the limb be in a state of flexion. It is in this position also that it is most easy to remark the kind of transverse furrow which corresponds to the femoro-tibial articulation, and which is more distinct than on the external side of the knee. Lastly, on the lateral parts of the articulation, we find the prominences of bone formed by the tuberosities of the condyles of the

femur, by those of the tibia, and on the outside by the head of the fibula. The posterior surface of the knee is concave, and constitutes the ham, the depth of which increases with the flexion of the joint. It is chiefly formed by the projections of the tendons of the biceps on the outside, and sartorius, semi-tendinosus, gracilis and semi-membranosus on the inside; projections which form its lateral boundaries, and between which may be distinguished the beginning of the calf of the leg, and the pulsations of the popliteal artery.

At the anterior part of the leg we find a vertical projection, formed by the crista of the tibia, on the outside of which may be observed the internal surface of this bone. The outer side of the leg presents, superiorly, a fleshy and rounded surface; inferiorly, a slight projection, formed by the fibula, and a depression separating that bone from the tendo Achillis. A similar hollow is observable on the internal side, between this tendon and the tibia, in which the posterior tibial artery is lodged. Lastly, on the internal and posterior part of the leg, the vena saphæna interna may generally be distinguished.

§ 275. The skin which lines the hollow of the ham is thin, and plentifully furnished with sebaceous follicles; that of the fore-part of the knee is thicker. On the anterior part of the leg likewise, the integuments are rather thick, but on the posterior, finer, whiter, and more yielding; in the adult male they are covered with hair. In front of the patella the subcutaneous cellular tissue forms a bursa mucosa, more or less distinct, and designed to favour the movements of that part; it occasionally happens, that the quantity of synovia contained in this bursa is so very much increased as to form a sort of encysted tumour, the posterior paries of which always adheres intimately to the patella. On the sides of this bursa mucosa, the subcutaneous cellular tissue is close and firm in its texture, forming only a very thin layer, and including but a small number of adipose vesicles. Hence wounds in this part, with loss of substance, cicatrize but slowly. In the ham the subcutaneous cellular tissue becomes thicker, and often contains a good deal of fat; at the posterior sur-

face of the leg it becomes almost completely lamellated, uniting very loosely the integuments to the subjacent fascia, and giving a ready passage to the matter which forms in the part; hence, in cases of abscess in this region, an early opening should be made, to avoid extensive separation of the skin.

§ 276. The *vena saphæna interna*, which we have already mentioned, is lodged between the deep layers of subcutaneous cellular tissue; so that its distance from the integuments depends on the thickness of this layer, and the quantity of fat contained in it. It rises on the back of the foot, passes in front of the malleolus internus, and ascends at first vertically on the internal surface of the tibia, and afterwards a little obliquely backwards towards the internal condyle of the femur, in front of which it passes. If this vein is about to be opened, the ligature should be applied a little above the malleolus, at the point where the vein rests on the tibia.

§ 277. The *crural aponeurosis*, above the knee, joins the tendons of the extensors of the leg; on the sides of the patella it is very thin, especially internally, and is fixed to the tuberosities of the tibia; posteriorly, it is, on the contrary, very strong, and continuous with the *fascia of the leg*. This arises also from the head of the fibula, and from fibrous expansions coming from the tendons of the extensors of the leg, sartorius, gracilis, and semi-membranosus; from the knee it descends around the leg, and is fixed along the whole extent of the anterior and internal edges of the tibia; its external surface is covered by the integuments, cellular tissue, vessels, and nerves; the internal rests on the superficial muscles of the leg, to several of which it affords attachments; several fibrous processes are given off, which form intermuscular septa, of which we shall speak hereafter. The fascia of the leg is not so thick as that of the thigh, but its firm and unyielding nature renders its division necessary when any considerable inflammatory swelling affects the soft parts situated beneath it, for the same reasons which we have already stated (§§ 148 and 168).

§ 278. Having removed the fascia, we perceive at

the posterior part of the knee a kind of rhomboidal figure, the sides of which are formed by the muscles of this part; it is the *pit of the ham.* The inferior extremity of the biceps, the tendon of which muscle bifurcates to fix itself to the head of the fibula, and to contribute to the formation of the fascia of the leg, constitutes the superior and external edge of this space; the superior and internal edge is formed by the semi-membranosus, semi-tendinosus, gracilis, and sartorius. The first of these muscles ends in a thick and rounded tendon, which divides into three portions, of which the middle is attached posteriorly to the internal tuberosity of the tibia, and the two lateral portions chiefly go to strengthen the femoro-tibial articulation. The semi-tendinosus, situated on the inside of the former, is more prominent than it; its tendon, slight and rounded, descends behind the joint, then turns from behind forwards, and is inserted into the tibia, together with the tendons of the gracilis and sartorius (§§ 262 and 266). The inferior angle of this rhomboidal space, much shorter than the superior one, is formed by the heads of the *gastrocnemius* muscle. That on the internal side is fixed to the femur above the posterior part of the internal condyle of that bone, and is covered, in part, by the semi-membranosus muscle. The external bundle is attached behind and above to the external condyle of the femur, and, like the internal, is only covered by the fascia. It increases in size as it descends, and ends in an aponeurosis, which, after joining that of its fellow, becomes united with the aponeurosis of the soleus. It is for the purpose of preserving the insertions of the last-mentioned flexor muscles, and the movements of the stump, that amputation of the leg is performed at a short distance from the anterior tuberosity of the tibia. The hollow of the ham, circumscribed internally, as we have just said, is continued inferiorly, beneath the gastrocnemius as far as the aponeurotic arch of the soleus; we find there a great quantity of adipose cellular tissue, lymphatic ganglia; and, proceeding from the external towards the internal boundary, the peroneal nerve, the vena

saphæna externa, the tibial nerve, the popliteal vein and artery.

§ 279. The *soleus muscle*, placed under the gastrocnemius (§ 278.), is of an oval figure, and arises superiorly from three distinct aponeuroses; the first, broad and thin, is fixed to the superior extremity, and external edge of the fibula; the second is disposed like an arch, the concavity of which is turned upwards: and lastly, the third is inserted along the posterior oblique line and the middle third of the internal edge of the tibia. The aponeurotic arch, of which we have been speaking, joins together the two lateral aponeuroses, and covers the popliteal vessels. Inferiorly, the fleshy fibres of the soleus terminate on a broad and thin aponeurosis, which joins that of the gastrocnemius, and thus assists in forming the tendo Achillis. This tendon, the largest and strongest of any in the body, descends perpendicularly behind the lower part of the leg, forming there a considerable projection, and fixes itself to the inferior half of the posterior surface of the os calcis. The power of the soleus and gastrocnemius muscles is so great, that their sudden and violent contraction may produce the rupture of the tendo Achillis, or even fracture of the os calcis; this severe accident is more frequently met with in dancers, being produced by a too violent extension of the foot. The superficial situation of the tendo Achillis allows the depression, caused by the separation of the two portions of the tendon (and which is increased by the flexion of the foot,) to be easily distinguished by the touch. Considering the points of attachment of these muscles, it becomes evident that, in order to unite again the divided parts, we must not only keep the foot fully extended on the leg, but also the leg a little flexed on the thigh.* Authors, for the most part, suppose that the tendon of the plantaris may likewise be ruptured; but M. Richard, we think, justly refers, to the rupture of some of the fleshy fibres forming the calf, those effects which

* {In a case of rupture of the tendo Achillis, Dr. Horner has employed the seton, in the same manner as recommended by Dr. Physick in ununited fractures, with the most complete success. W.}

have been attributed to that of this tendon. In fact, the *plantaris* muscle, placed before the gastrocnemius, and behind the soleus, the popliteal vessels, and the knee-joint, is narrow, lengthened, and extremely thin; it is fixed, superiorly, to the external condyle of the femur, descends obliquely outwards, and after a passage of two or three inches, ends in a thin, narrow, and very long tendon, which unites itself to the internal side of the tendo Achillis, about the inferior third of the leg, and goes to fix itself to the os calcis; hence it would seem very difficult for its rupture to be produced by the contraction of so few muscular fibres.

The anterior surface of the soleus muscle is in relation with the deep layer of muscles, the popliteal vessels, the tibialis posticus and peronei. A tendinous expansion passes behind the tendo Achillis, ascends as far as the popliteus muscle, and with the posterior portion of the fascia of the leg, forms a sheath which surrounds this tendon; behind which we find a great quantity of fatty cellular tissue intermixed with albugineous fibres.

§ 280. The *sciatic nerve*, (§ 262.) arrived at the ham, divides into two principal trunks, the tibial and peroneal nerves. This last descends obliquely outwards, along the inferior extremity of the biceps, behind the external condyle and the tendon of the gastrocnemius, and then turns forwards and inwards to pass between the superior part of the fibula and the peróneus longus muscle. The internal branch, larger than the preceding, descends at first nearly perpendicular along the internal edge of the semi-membranosus, between the aponeurosis and the popliteal vessels, next dips between the heads of the gastrocnemius, passes behind the knee-joint and the popliteus muscle; and lastly, having traversed the soleus muscle, takes the name of tibial nerve. In general, a considerable quantity of adipose cellular membrane separates this nerve from the popliteal vessels. The popliteal vein covers the artery, and is found, at first, a little on its outer side. The vena saphæna externa, which rises on the back of the foot, passes behind the malleolus externus, and ascends obliquely towards the ham, then proceeds by the side

of the nervus tibialis, and opens into the popliteal vein.

§ 281. The *popliteal artery* is the continuation of the femoral, and takes this name immediately it has passed through the tendon of the adductor magnus. From this point it descends somewhat obliquely outwards, and ceases to be popliteal about the superior fourth of the leg. It is covered immediately by the vein, which intimately adheres to it by means of cellular tissue, the popliteal nerve, the femoral fascia, and the integuments; superiorly, it is likewise in relation with the semi-membranosus muscle, by its posterior surface. Inferiorly, it passes beneath the gastrocnemius, plantaris, and soleus; superiorly, the anterior side of this vessel is separated from the femur by a large quantity of adipose tissue; about the middle of the ham, it rests on the femoro-tibial articulation; in its lowest part, it is contiguous to the popliteus and tibialis posticus muscles.

When the coats of the popliteal artery give way, the blood exudes and a tumour soon forms, which gradually increases in size; but the *crural fascia*, strengthened in this part by several transverse ligamentous bands, strongly opposes the distension from before backwards, and forces the aneurism to assume an oblong form, in the direction of the axis of the knee, owing to the rhomboidal figure we have mentioned above. Another result of this arrangement of the fascia is that the posterior parietes of the aneurismal sac, formed as they are by this fascia and a large quantity of condensed cellular tissue. are much thicker than the anterior ones, which consist only of the loose cellular tissue which separates the artery from the bone. The severe pains, fulness and numbness of the leg, sometimes observed in cases of popliteal aneurism, are likewise consequences of the anatomical disposition of the parts, by which the nerves and vessels lodged with the artery in the pit of the ham are more or less compressed. The experiments of M. Richerand also go to show that the situation of the popliteal artery in the midst of a large quantity of very extensible cellular tissue, and immediately behind the knee-joint, must expose it to a cer-

tain degree of displacement, whenever the limb is forcibly extended, causing in part the great frequency of popliteal aneurisms. The long-continued contraction of the muscles of the calf appears also capable of giving rise to this disease, by compressing the artery in its lower part.

In the case both of wounds and aneurism of the popliteal artery, its deep situation and the nervous trunks which cover it, prevent an advantageous employment of compression, and we must, therefore, have recourse to the ligature of the femoral artery. The ligature of the popliteal artery presents greater difficulties, and less chance of success; in consequence, the ancient method of opening the tumour, and then tying the artery both above and below it, is now almost universally abandoned for Hunter's mode, which consists in tying the diseased vessel at a point more or less distant from the seat of the disease.

The principal branches furnished by the popliteal artery in passing through the ham, are the articular, five in number; they are distinguished according to their position into superior-external, superior-internal, superior-middle, inferior-external, and inferior-internal; they surround the knee, and present numerous anastomoses.

§ 282. About the level of the head of the fibula, the popliteal artery gives off the anterior tibial, which passes horizontally forwards, and of which we shall presently speak. About an inch below this point, the popliteal artery bifurcates to form the peroneal and posterior tibial arteries. It is to avoid the division of the popliteal vessels, and to preserve the attachments of the flexor muscles, that we do not amputate the leg above a line situated about four fingers' breadth below the anterior tuberosity of the tibia; on the other hand, were we to leave too long a stump, it would be exposed to accidents of all kinds. The *posterior tibial artery* takes a direction a little obliquely inwards, and then descends almost perpendicularly between the superficial and deep layers of muscles on the back of the leg; its passage answers nearly to a straight line drawn from the middle of the ham to the posterior part of the

malleolus internus. At the superior part of the leg it is covered by the soleus and gastrocnemius muscles; but, about its inferior third, it disengages itself gradually from under the tendo Achillis, and becomes placed at its inner side, immediately under the fascia of the leg. Anteriorly it corresponds to the interosseous space, to the tibialis posticus, and flexor longus communis, and to the posterior surface of the tibia. There are frequently two veins accompanying this vessel, one on each side of it. As to the tibial nerve, (§ 279.) we shall only observe that it descends towards the os calcis along the external edge of the artery to which it is attached.

To tie the posterior tibial artery towards the inferior third of the leg, we have only to divide the integuments, the fascia, and the cellular tissue between the tibia and the inner edge of the tendo Achillis. But about the superior third of its course, this operation is much more difficult; in fact, to reach the vessel, we must make, along the internal edge of the tibia, an incision extending from the posterior and inferior part of the internal tuberosity of that bone to the middle of the leg. The integuments and the fascia of the leg having been thus divided, we must dissect the fibres of the soleus muscle, which are fixed to the internal edge of the tibia and to its oblique line, turn this muscle and the inner head of the gastrocnemius outwards and backwards, and then divide the aponeurosis which passes behind the artery and deep-seated muscles. Sometimes it even becomes necessary to cut transversely the fleshy fibres of the soleus and gastrocnemius muscles.

§ 283. The deep-seated layer of muscles on the back of the leg, is formed by the *popliteus*, the flexor communis digitorum, tibialis posticus, and flexor longus hallucis. The first of these muscles, short, flat, and nearly triangular, is placed behind the knee-joint; it is fixed in a hollow on the tuberosity of the internal condyle of the femur, and to the triangular surface visible on the posterior and upper part of the tibia. The *flexor communis perforans* is fixed to the posterior surface of the tibia, from its oblique line to its inferior fourth, and to a fibrous septum, arising from the fascia

of the leg, and common to this muscle, and the tibialis posticus, and flexor longus hallucis; inferiorly, it terminates in a tendon, which passes behind the malleolus internus, and divides on the sole of the foot into four separate tendons. The posterior surface of this muscle is in relation with the soleus, the fascia and the posterior tibial artery; the anterior covers the tibia and the *tibialis posticus* muscle. This muscle, long and of a prismatic form, is bifurcated, superiorly, to allow the passage of the anterior tibial vessels; one of its portions is fixed to the inner and back part of the fibula; the other to the linea obliqua of the tibia, and to the interosseous ligament; it also receives fibres arising from the tendinous partition mentioned above, and ends by a tendon which passes behind the malleolus internus, together with that of the flexor communis perforans. The *flexor longus hallucis* is fixed to the two inferior thirds of the posterior surface of the fibula, to the tendinous partition which separates it from the above-named muscles, and to another fibrous process placed between its external edge and the peronei muscles; at the bottom of the leg it ends by a tendon which enters into a notch formed behind the lower extremity of the tibia, and at the posterior surface of the astragalus.

§ 284. The *peroneal* artery, the origin of which has been already stated (§ 281.), proceeds a little obliquely inwards, from the termination of the popliteal artery to the malleolus internus, along the edge and internal surface of the fibula. Covered posteriorly by the soleus and flexor longus hallucis, this vessel rests on the tibialis posticus superiorly; but traverses it inferiorly, to get between its anterior surface and the interosseous ligament. Wounds of the peroneal artery are of rare occurrence, owing to its deep situation and small size; in order to tie it, M. Lisfranc recommends an incision through the integuments obliquely from within outwards and from below upwards, from the external edge of the tendo Achillis to the posterior and external surface of the fibula, taking care to avoid the vena saphæna externa. Next, the fascia must be divided, the superficial being separated by the finger from the deep-seated layer of muscles, and then the aponeurosis covering

the deep layer. Lastly, the internal edge of the flexor longus hallucis, behind which is found the artery, must be directed outwards.

§ 285. The fleshy mass situated at the external and anterior part of the leg, is formed by the tibialis anticus, extensor longus hallucis, extensor longus communis, peroneus tertius, and the two *peronei laterales*. The four first are lodged in a sort of groove formed by the fascia of the leg before, behind by the interosseus ligament, the tibia on the inside, and the fibula on the outside. The *tibialis anticus* muscle is fixed to the external tuberosity and to the superior half of the external surface of the tibia, to the interosseous ligament, to a fibrous partition separating it from the extensor longus communis, and to the upper part of the internal surface of the fascia of the leg. About the inferior third of the leg, it terminates by a tendon which passes in front of the inferior extremity of the tibia and of the ankle-joint. The external edge of this muscle is united above to the *extensor longus pollicis*, which arises from the internal surface of the fibula, and from the interosseus ligament, and whose tendon passes likewise under the annular ligament of the tarsus; inferiorly, it is separated from it by the anterior tibial nerve and vessels. The *extensor longus communis* is placed on the outside of the two last, from which it is separated by a fibrous partition; it arises from the anterior part of the fibula, from the interosseous ligament and the aponeurosis surrounding it, and its tendon does not cease to be provided with fleshy fibres till it arrives on a level with the annular ligament. The external edge of this muscle is united superiorly to the peroneus longus, in the middle to the peroneus brevis, and inferiorly to the *peroneus tertius*. This last muscle does not constantly exist; it is fixed to the inferior third of the anterior part of the fibula, and ends by a tendon which passes under the annular ligament, to become inserted on the fifth bone of the metatarsus.

§ 286. The *anterior tibial* artery, having left the popliteal on a level with the head of the fibula, proceeds horizontally forwards, traverses the superior extremities of the tibialis posticus, and of the interosseous liga-

ments, turns downwards, and descends obliquely along the anterior part of the leg. It rests during this passage on the interosseous ligament, excepting about the lower part of the leg; and on the tibia it is covered, in succession, by the tibialis anticus, extensor communis, and extensor pollicis, the tendon of which last is the only part which separates it inferiorly from the fascia of the leg. Its internal side corresponds to the tibialis anticus and to the tibia; its external to the fibula, to the peroneus longus, extensor communis, and extensor pollicis muscles. The *anterior tibial* nerve, given off from the external popliteal (peroneal) branch, traverses the upper ends of the peroneus longus, and extensor communis muscles, descends obliquely between these muscles and the fibula, then between the extensor communis, extensor pollicis, and tibialis anticus in front of the interosseous ligament, where it is in relation with the artery, superiorly, by its internal, and inferiorly, by its external, side. Two veins accompany this vessel, one on each side; lastly, all these parts are united by cellular tissue, which in many points is of a rather firm texture.

It will be seen, then, that in order to tie the anterior tibial artery at the lower part of the leg, where it rests on the tibia, the incision through the integuments and fascia must be made between the tendon of the extensor pollicis, which covers the vessel, and that of the extensor communis. To perform this operation about the upper third of the leg, it is necessary to make a long incision in the direction of the external edge of the tibialis anticus, and then to separate this muscle from the two extensors from below upwards; we shall then find the artery upon the interosseous ligament, about an inch deep, on the outside of the tibialis anticus, but it is not always possible to isolate it from the accompanying veins.

§ 287. The two *peronei laterales* muscles occupy the external part of the leg; the first, the longest of the two, is fixed to the superior third of the external surface of the fibula, to the tibia, to the fascia of the leg, and to those fibrous partitions which separate it on one side from the soleus and flexor longus pollicis,

and on the other from the extensor communis longus. About the lower third of the leg, it terminates by a tendon which passes along the fibula, behind the malleolus externus, and goes to be attached to the first bone of the metatarsus. The peroneus brevis arises from the inferior half of the external surface of the fibula and the aponeuroses which surround it; its tendon enters the same groove as that of the preceding muscle, and ends on the fifth bone of the metatarsus.

§ 288. The bones of this portion of the lower extremity consist of the lower end of the femur, the patella, the tibia, and the fibula.

The patella, a small flattened bone of an irregularly triangular shape, occupies the anterior part of the knee. Its anterior surface is convex, and covered by fibrous and aponeurotic expansions, and afterwards by the integuments; its posterior surface is divided into two portions by a projecting line, which descends obliquely inwards; the two surfaces thus formed are covered with cartilage, and articulated with the condyles of the femur. The base of the patella, which is also its thickest part, is directed upwards, and into it the common tendon of the extensors of the leg is inserted. Its lateral edges, which are thin and prominent, afford attachments to aponeuroses given off from the extensors; lastly, its apex serves for the attachment of the *ligament of the patella*. The fibrous cord to which this name has been given, seems to be only the continuation of the tendon of the four extensors of the leg, in the centre of which the patella has been developed; it is flattened, about two inches long, fixed inferiorly to the *anterior tuberosity* of the tibia, and separated from the articulation of the superior extremity of that bone by a considerable bundle of adipose tissue, and by a synovial bursa. As a consequence of this arrangement, the patella has a tendency, when the limb is bent and the extensor muscles of the leg violently contracted, to be twisted backwards; in fact, it then rests by a point only on the anterior part of the condyles of the femur, and the ligament of the patella fixes its lower end to the tibia, whilst the vasti, cruræus, and rectus, carry its upper

end backwards. The transverse fracture of the patella takes place, therefore, whenever the action of these muscles is greater than the resistance offered by the bone, and it is clear that when the extensor muscles can no longer act on the leg, it must become flexed, and the patient will fall on his knees. The fracture of this bone may likewise be produced by causes acting immediately on it; for instance, by falls on the knees, but this is a very rare occurrence, because the leg must form with the thigh a very acute angle before the patella will be required to support the whole weight of the body. In such cases, the fracture is also transverse, because the shock excites a contraction of the extensor muscles, which combine their force with that of the direct percussion. The longitudinal fracture is extremely rare, and can arise only from some great violence directly applied to the part.

§ 289. The *inferior extremity of the femur* is very large, somewhat flattened from before backwards, and thinner in the centre than on the sides, where the condyles are situated. The linea aspera, which descends, as we have seen, along the posterior surface of the body of the femur (§ 268), bifurcates at a short distance above the condyles; its internal line, which has a depression superiorly, for the passage of the femoral artery, reaches the posterior part of the inner condyle, and gives attachment to the adductor magnus and triceps cruralis; the external, more prominent, passes to the outer condyle, and serves for the insertion of the triceps cruralis and biceps; the triangular and flattened surface between these two lines corresponds to the popliteal vessels and nerves. The condyles of the femur are two considerable eminences, which are articulated with the tibia; that on the inside is less prominent forwards and more prolonged backwards and downwards than the outer; but, when the femur is in its natural situation, they are on the same level, in consequence of the oblique position of that bone. The condyles are more convex behind than before, and are separated anteriorly by a surface concave transversely, convex from above downwards, and covered with cartilage. In this sort of articular pulley the patella is

placed; it is kept there by its own ligament, by the tendons of the extensors and aponeuroses given off by these muscles, and by the capsular ligament of the knee-joint; but it has a free motion, and may be luxated upwards, downwards, inwards, and outwards. The dislocations upwards and downwards are only consequences of the rupture of the ligament of the patella or the tendons of the extensors of the leg; the dislocation inwards takes place with more ease than in the contrary direction, because the internal edge of the patella, more projecting than the external, passes beyond the internal boundary of the articular pulley, and, consequently, gives more purchase to the causes which tend to push it in that direction. The greater projection of the external condyle of the femur had given rise to the opinion that dislocations inwards would be naturally most frequent; but, according to M. Boyer, experience has not confirmed the conjecture. Posteriorly, the condyles of the femur are separated by a perpendicular notch of considerable depth, which lodges the ligamenta cruciata of the knee. Above the lateral surfaces of the condyles the uneven projections called the tuberosities of the femur, are situated, affording insertion to the lateral ligaments of the joint, and to some muscles. The fracture of the femur, immediately beneath the condyle, is rare, owing to the great thickness of the bone at this point; when it does take place, the lower end of the bone is carried backwards by the contraction of the gastrocnemius, plantaris, and popliteus muscles.

§ 290. The *superior extremity of the tibia*, of large size, and in shape transversely oval, presents above two surfaces, concave and covered with cartilage, to be articulated with the condyles of the femur; the internal is oval from behind forwards; the external, not so deep as the other, is nearly circular, and directed somewhat obliquely downwards and outwards. Between these two surfaces is found a pyramidal process, called the spine of the tibia, which gives attachment to the semilunar cartilages and the ligamenta cruciata. Anteriorly, the superior extremity of the tibia is bounded by a triangular surface, oblique forwards and downwards,

and terminated below by a tubercle, where the ligament of the patella is inserted; behind, there is a notch; and lastly, on the sides are two eminences called the tuberosities of the tibia; the internal, the most prominent of the two, gives attachment to the internal lateral ligament, and to the tendon of the semi-membranosus; the external presents a small convex surface, directed downwards, and covered with cartilage, to be articulated with the fibula.

The articulation of the femur and tibia is strengthened by a great many ligaments and by inter-articular cartilages; these last, which have been also called semilunar ligaments, are placed between the condyles of the femur and the cavities of the upper end of the tibia. Their shape is that of a crescent, and they are much thicker at their outer than their inner circumference. The lateral ligaments, two on the outer and one on the inner side of the knee, are fibrous bundles, passing from the tuberosities of the femur to those of the tibia, or to the head of the fibula, and are strengthened by aponeurotic expansions from the neighbouring tendons. The *posterior ligament* passes obliquely from the external condyle of the femur, to the internal tuberosity of the tibia; it is covered by an aponeurosis from the semi-membranosus muscle, and separated from the ligamenta cruciata by vessels and a quantity of fat. The ligamenta cruciata, arranged so as to represent an X, are very strong, and fixed to the spine of the tibia and the condyles of the femur. The number and strength of these ligaments, as well as the extent of the articulating surfaces, and the number of tendons surrounding the knee, give great firmness to this joint. The tibia is nevertheless capable of being dislocated backwards, forwards, and on the sides. The dislocation forwards is almost impossible, since the flexion of the leg may be carried very far, before the articulating surface of the tibia will no longer be in relation with the condyles of the femur; besides, the ligament of the patella and the tendons of the extensor muscles strongly oppose this accident. The crucial, posterior, and lateral ligaments all oppose an excessive extension of the leg. Hence, in order that the luxation

backwards should take place, they must be torn, and the gastrocnemii, poplitei, and extensors of the leg, considerably lengthened. The lateral dislocations are more frequent; but they are almost universally incomplete, owing to the great extent of articular surface in the transverse direction.

In the amputation of the leg at the femoro-tibial articulation, the flap intended to cover the stump must be taken from the muscles of the calf. A semicircular incision must be made before and below the patella, and the ligament of the patella and the lateral ligaments be divided. The knee is then flexed, to allow of the division of the ligamenta cruciata and the passage of the knife from above downwards, and from before backwards, between the tibia and the skin covering the posterior surface of the knee. But the common amputation of the leg or thigh is usually preferred to this operation.

§ 291. The body of the tibia is prism-shaped; its size diminishes from above downwards, but the point at which it is weakest is at the junction of the middle with the inferior third, in which point it is most frequently fractured. It presents a double curvature, so that its inner surface, which is subcutaneous, is slightly convex superiorly, and somewhat concave in its lower third. The external surface has the contrary disposition, and is covered by the tibialis anticus, and by the tendons of the extensor communis, extensor proprius pollicis, and peroneus tertius. The posterior surface, which is convex in its whole extent, is traversed superiorly by a projecting line, oblique from above downwards and from within outwards, and into which are inserted the pópliteus, soleus tibialis posticus, and flexor longus. Of the three edges which separate these surfaces, one is external, and serves for the attachment of the interosseous ligaments, one internal, offering nothing worthy of remark, and the third, or anterior one, called the *crest of the tibia* (shin); it is here that we most easily perceive the inequalities which accompany the fracture of the bone.

§ 292. The fibula, situated on the outside of the tibia, and very much slighter, is directed a little oblique-

ly downwards and forwards. The upper end of this bone is rounded, and bears the name of head of the fibula. We observe on it a surface directed inwards and forwards, for articulation with the one we noticed on the external tuberosity of the tibia; behind, it terminates by a pyramidal eminence directed upwards, around which are inserted, the external lateral ligament, the tendon of the biceps, and the two ligaments which join this bone to the tibia.

The body of the fibula, slender and rounded above, prismatic in the rest of its extent, is twisted on itself, and slightly curved inwards. We observe on its internal surface a longitudinal crest, on which the interosseous ligament is fixed. This fibrous membrane occupies the space left between the two bones of the leg, and presents above and externally a considerable orifice for the passage of the anterior tibial vessels.

One or both bones of the leg may be fractured: in the former case, the leg is for the most part bent backwards, from the muscles of the back of the leg being stronger than those of the front. When the fibula alone is fractured, the limb is not shortened, but the direction of the foot is changed, as we shall see hereafter; and the two ends are drawn against the tibia; lastly, when the tibia alone is fractured, the displacement is very inconsiderable.

CHAPTER XVII.

REGION OF THE FOOT.

§ 293. To terminate the description of the lower extremities, we have yet to speak of the foot and the lower portion of the leg, parts too closely connected to allow of their being separately described. At the bottom of the leg we observe, on each side, a rounded projection called malleolus; the inner, formed by a process of the tibia, is separated from the tendo Achillis

by a very marked depression; the outer, formed by the lower end of the fibula, is also separated from that tendon by a sort of perpendicular groove, at the anterior part of which may be felt the tendons of the peronei laterales muscles. In carrying the foot inwards, we also perceive in front of the malleolus externus, and on the outside of the instep, a projection, formed by the head of the astragalus; on its external and inferior side is a pit, bounded behind by the astragalus and the os calcis; internally, by the scaphoid; externally, by the cuboid; and in front by the third os cuneiforme, which forms a projection in front of the cuboid. Following with the finger the outer and lower edge of the foot from behind forwards, we meet below this eminence a depression, bounded in front by a marked projection, and formed by the posterior extremity of the fifth bone of the metatarsus. Proceeding along the inner edge of the foot, the first projection we observe, before the malleolus, is the scaphoid, about twelve lines in front of which the posterior extremity of the first bone of the metatarsus is situated, which may be felt by carrying the fingers along the inner and inferior edge of the foot. Behind this projection there is a depression which corresponds to the tarso-metatarsian articulation, and which is bounded anteriorly by a second bony projection. A knowlege of these details is very important in partial amputations of the foot.

§ 294. At the lower part of the leg the skin is in general thin and adherent to the parts beneath, especially towards the inner malleolus. Hence wounds of these parts, with loss of substance, cicatrize with difficulty. The saphæna interna vein, formed by the union of several smaller veins lodged in the cellular tissue of the ankle, ascends in front of the internal malleolus. In very fat persons this spot is sometimes chosen for bleeding, the vein being more superficial here than at the inferior part of the leg. The saphæna externa also makes its appearance near this part, but it is in general too small to be easily opened. On the heel, the integuments are very thick and rough, but it is on the sole of the foot that they are most remarka-

ble for their firmness, hardness, want of elasticity, and great thickness. Tumours, therefore, form in this part with great difficulty, and occasion the most severe pains. On the back of the foot the skin is much thinner, but it is tightly applied to the parts beneath it.

§ 295. The *tibial aponeurosis*, at the inferior part of the leg, is attached internally to the ligament of the inner malleolus, and externally to the sheath of the tendon of the peronei muscles. Posteriorly, it disappears towards the heel, and is lost in a thick and elastic layer of cellular tissue, which contains some fat, and very closely unites the integuments to the subjacent parts. Anteriorly, the tibial aponeurosis is continuous with the *anterior annular ligament.* This is a fibrous quadrilateral bundle, much thicker externally than internally, and extended transversely across the ankle. Attached externally to the interior and outer part of the superior depression of the os calcis, this ligament proceeds inwards, and soon divides into two layers to surround the tendons of the extensor digitorum and peroneus tertius. Lastly, after uniting and separating again to form a sheath for the tendons of the tibial anticus and extensor pollicis, these layers are inserted in front of the internal malleolus. A very thin aponeurotic layer is given off from the lower edge of this ligament on the dorsum of the foot, and towards the joints of the phalanges degenerates into cellular tissue.

§ 296. Beneath the aponeurosis, we find, proceeding from within outwards, *the tendon of the tibialis anticus*, which descends in front of the tibio-tarsian articulation, and then enters into the sheath of the annular ligament of the tarsus, where it is covered by a synovial bursa. It then proceeds forwards and inwards to be attached to the base of the os cuneiforme internum and posterior extremity of the first bone of the metatarsus.

The tendon of the extensor pollicis passes beneath the annular ligament in a distinct sheath by the side of the preceding, and lastly terminates on the phalanx of the great toe. The tendon of the extensor digitorum communis divides into four portions, which, after their passage beneath the annular ligament; separate from

each other to be distributed to the four outer toes. They join the tendons of the flexor brevis, receive processes from those of the lumbricales and interossei, and spread out in a kind of aponeurosis, which covers the superior surface of the toes. Lastly, the tendon of the peroneus tertius passes into the same sheath as the tendons of the extensor communis, and is attached to the head of the fifth metatarsal bone.

The *flexor brevis digitorum*, situated at the superior and external part of the foot, beneath the tendons of the extensor longus, is attached posteriorly to the superior portion of the calcaneum, and to the adjoining ligaments. From thence its fleshy fibres proceed forwards and inwards, and soon divide into four bundles, the tendons of which cross those of the extensor communis, pass obliquely on the metatarsus, and go to be attached to the four first toes.

§ 297. The anterior tibial artery, when it reaches the inferior part of the leg, between the peroneus longus and tibialis anticus, passes beneath the anterior annular ligament, between the extensor longus digitorum, and extensor proprius pollicis. It then assumes the name of *dorsal artery of the foot*, and proceeds obliquely forwards and inwards towards the posterior extremity of the metatarsus, where it passes beneath the tendon of the extensor brevis to reach the sole of the foot. During this course the vessel is covered by the common integuments, the tendons of the extensor digitorum, and by the extensor brevis. The principal branches which are given off are the tarsal and the metatarsal. The former arises on the level with the scaphoid, and proceeds forwards and inwards beneath the extensor brevis; the latter takes its origin lower down. near the spot where the anterior tibial dips into the first interosseal space, and proceeds forwards and outwards beneath the extensor brevis. describing a curve, the concavity of which is turned forwards. This vessel gives origin to three principal branches, called the *interosseal arteries of the foot*. These vessels, lodged in the third and fourth interosseal spaces, proceed forwards, and communicate towards the extremities of the bones of the metatarsus, with the posterior perforating branches

of the external plantar; and lastly, divide into two branches, which go along the corresponding edges of the toes. In order to take up the anterior tibial artery on the dorsum of the foot, it is merely necessary to divide the integuments and dorsal aponeurosis. The incision should be about two inches in length, and ought to be made in the direction of the second toe; the artery is there situated at the outer side of the tendon of the extensor pollicis, and on the inner side of the extensor digitorum.

§ 298. The anterior tibial nerve passes beneath the anterior annular ligament, with the artery, and immediately after divides into two branches. The internal one proceeds forwards along the inner edge of the extensor brevis; the external one proceeds forwards and outwards, beneath the posterior part of this muscle. In order to avoid including the former of these branches when tying the anterior tibial artery, it is necessary to pass the needle beneath this vessel from within outwards.

§ 299. On the internal part of the ankle-joint, a fibrous band is situated, which proceeds from the anterior part of the inner malleolus to the posterior and internal part of the calcaneum, and forms with these bones a canal, through which the tendons of the tibialis posticus, flexor longus digitorum, flexor longus pollicis, and the plantar vessels and nerves pass; this is called the *internal annular ligament*. Superiorly, it is continuous with the tibial aponeurosis; inferiorly, it gives attachment to the adductor pollicis. At the posterior part of the joint, the tendo Achillis is situated, which is separated from it by a great quantity of fatty cellular tissue. A synovial capsule separates this from the upper half of the anterior surface of the calcaneum, and greatly facilitates its motions; lastly, the inferior half of this bone gives attachment to the tendo Achillis.

§ 300. On removing the integuments from the sole of the foot, we observe a very elastic thick layer of fatty cellular tissue, which closely unites the skin to the *plantar aponeurosis*. This membrane is analogous to the palmar aponeurosis, but much firmer and stronger.

It is triangular, and appears formed of three distinct portions; the middle is broader and thicker than the two lateral, and is attached to the posterior and inferior part of the calcaneum, where it appears to be continuous with the tendo Achillis. After sending septa to the superficial muscles of the sole of the foot, this plantar aponeurosis divides in front of the tarsus into five processes, which are distributed to the sides of the metatarso-phalangian articulations. The lateral portions of this aponeurosis are very thin, and cover the muscles of the great and little toes.

§ 301. The fleshy projection situated on the inner side of the foot, is formed by the *flexor and adductor brevis muscles of the great toe;* the first of these muscles is attached to the posterior, lower, and internal part of the calcaneum, to an aponeurotic septum, which separates it from the flexor brevis, to the internal annular ligament, and to the posterior part of the plantar aponeurosis. From thence its fibres proceed forwards and a little outwards, and terminate in a tendon which is inserted into the inferior and internal part of the first phalanx of the great toe. The flexor brevis pollicis, situated to the outer side of the preceding muscle, is attached to the inferior and anterior part of the os calcis, to the two last cuneiform bones, and to their ligaments. Its anterior surface is bifurcated; the internal fasciculus terminates in a tendon which joins the preceding muscle; the external is attached below and to the outer side of the first phalanx of the thumbs. Between these two muscles and the arch of the os calcis. the tendons of the flexor longus digitorum, flexor longus pollicis, tibiales anticus et posticus, and the plantar vessels and nerves are situated.

§ 302. The muscular projection on the outer side of the foot is formed by the *abductor and flexor brevis minimi digiti;* the first of these muscles is covered by the plantar aponeurosis, and closely adheres to it posteriorly. It is also attached to the inferior surface of the os calcis, to the septum which separates it from the flexor brevis, and to the fifth bone of the metatarsus. From thence its fibres proceed forwards, and terminate in a tendon which is inserted into the outer and poste-

rior part of the first phalanx of the little toe. The flexor brevis is attached to the posterior extremity of the fifth bone of the metatarsus, and to the ligamentous sheath of the tendons of the peroneus longus.

The flexor brevis digitorum, situated between the two muscular prominences of which we have just spoken, is separated from them by aponeurotic septa, and is attached to the posterior and inferior part of the os calcis. Towards the middle of the sole of the foot it divides into four bundles, the tendons of which pass between the processes of the plantar aponeurosis into the fibrous sheaths placed upon the toes, and are then attached to both sides of the second phalanx of the three last toes. The inferior surface of this muscle is united to the plantar aponeurosis; the superior is in relation with the lumbricales, flexor accessorius, plantar vessels and nerves, and the tendons of the flexor longus digitorum. The *lumbricales*, four in number, arise from the tendon of the flexor communis, proceed forwards, and terminate in small tendons, which pass between the processes of the plantar aponeurosis, and go to be inserted to the internal and inferior part of the base of the first phalanx of the four last toes.

§ 303. The posterior tibial nerve becomes superficial towards the lower part of the leg, and is situated on the inner side of the tendo Achillis; it then dips down beneath the arch of the os calcis, above the insertion of the adductor pollicis, and divides into two branches. The one, called the *internal plantar nerve*, proceeds directly forwards, above the muscle of which we have been speaking, and divides into several branches, which go to the sides of the four first toes. The *external plantar nerve* proceeds obliquely forwards and outwards above the flexor brevis digitorum.

§ 304. The posterior tibial artery, beneath the arch of the os calcis, also divides into two branches, which are called *plantar arteries*. The internal, at first concealed beneath the internal annular ligament, proceeds horizontally forwards above the adductor pollicis. Towards the middle of the sole of the foot it turns a little inwards, and passes beneath the short flexor of this toe, and goes to anastomose with the first collateral ar-

teries. The external plantar artery, like the nerve to the outer side of which it is situated, proceeds obliquely downwards and outwards on the flexor brevis digitorum. It thus takes a course forwards between this muscle and the abductor pollicis, then bends inwards towards the posterior extremity of the fifth metatarsal bone, and dips beneath the abductor pollicis to form the plantar arch.

§ 305. The *flexor accessorius* is situated above the vessels and nerves of which we have been speaking, at the posterior part of the sole of the foot. It is attached to the internal and outer surfaces of the os calcis, and terminates on the external and superior part of the tendon of the flexor digitorum, near the point where it divides. This tendon passes behind the internal malleolus, in a fibrous sheath, which is common to it and the tendon of the tibialis posticus, and is surrounded by a bursa mucosa, which is continued beneath the arch of the os calcis. Beneath the sole of the foot it proceeds obliquely forwards and outwards, and divides into four thin tendons, which are attached to the phalanges of the four last toes, proceeding in a manner similar to those of the flexor profundus digitorum. The *abductor pollicis*, situated on the outer side of the flexor brevis, is short and of a prismatic shape; it is attached to the inferior surface of the cuboid, to the third and fourth bones of the metatarsus, and terminates at the external and inferior part of the first phalanx of the great toe. Its inner side is in relation with the flexor brevis and the tendon of the peroneus longus. This tendon, after having passed behind the external malleolus, enters into a groove on the outer surface of the calcaneum, in which it is retained by a fibrous sheath; turns round beneath the head of this bone, where it is retained in the same manner; and, lastly, goes to be inserted into the posterior extremity of the first bone of the metatarsus. The outer surface of the abductor is in relation with the interosseous muscles and external plantar artery. This vessel, after dipping between them and the interosseous muscles, describes a curvature, the convexity of which is thrown forwards, and anastomoses with the anterior tibial, below the first bone of

the metatarsus. It is on account of the great number of direct communications which exist between the different arteries of the foot, that, in wounds of the posterior tibial, one ligature is not sufficient to arrest the hæmorrhage; two ligatures being always necessary, one above, the other below, the opening of this vessel. From the convexity of the *plantar arch*, the collateral arteries of the toes arise, which, however, present nothing interesting in a surgical point of view.

§ 306. Above the different parts of which we have been speaking, we again observe the *abductor transversus pollicis*, and the interosseous muscles; the former extends transversely beneath the heads of the four last bones of the metatarsus. The interosseous muscles, seven in number, are attached on the phalanges. Those of the dorsal surface of the foot are covered by a cellulo-aponeurotic layer, which is in general very thin, and extends from one bone of the metatarsus to the other. In addition they present nothing of interest.

§ 307. The bones of the foot, like those of the hand, consist of a great number of small bones firmly united together. They are divided into phalanges, metatarsal, and tarsal bones; but before we describe them, we have to speak of the inferior extremity of the bones of the leg. The *tibia* is terminated inferiorly by a quadrilateral, concave, articular surface, which is separated into two lateral parts by a superficial ridge. The anterior surface of the inferior extremity of this bone is convex, and gives attachment to ligaments; posteriorly, it is traversed obliquely downwards and outwards by a sulcus, which lodges the tendon of the flexor longus pollicis; externally, it is concave and triangular, and articulated with the fibula. Internally, it is prolonged below the surface of the tarsus, in the form of a thick process, being triangular and flattened from without inwards. The internal surface of this bony process, which is called *malleolus internus*, is convex and covered merely by skin; externally, we observe a small surface for articulation with the astragalus. Its anterior edge is thick and rounded; the posterior is crossed by one or two superficial sulci, directed obliquely downwards and inwards, and lodging the tendons of the

tibialis posticus and flexor communis. The internal surface of the malleolus is covered with cartilage, and joined to the articular surface of the tarsus, of which we have before spoken.

§ 308. *The inferior extremity of the fibula* forms the outer ankle; it is elongated, and flattened transversely, and descends lower down than the inner ankle. Its external surface is also convex, and only covered by skin; the internal presents a small smooth articular surface, convex from above downwards, and bounded posteriorly by a rough groove, which serves for the insertion of one of the posterior ligaments of the joint. This surface is united to the astragalus, and is bounded superiorly by a triangular and convex surface, by which the fibula is articulated with the tibia. A fibrous bundle, which is attached, for a considerable extent, to the inferior extremity of the fibula, and to the neighbouring portion of the tibia, is extended obliquely in front of the articulation of these bones. The posterior ligament of the joint ascends obliquely from the fibula to the tibia. Lastly, the inferior interosseous ligament, which appears to be the continuation of the fibrous membrane extended between the body of these two bones, fills the space left between these articular surfaces just above their cartilages.

§ 309. The *tibio-tarsal articulation*, or ankle-joint. is a perfect angular ginglymus; the lower portion of the tibia, united to that of the fibula, presents a quadrilateral cavity, bounded laterally by the ankles, and completely filled by the astragalus, which is received into it. The anterior surface of this last bone occupies the posterior two-thirds of its superior surface; it is convex from behind forwards, and a little concave transversely; the ligaments which serve to keep it in relation with the articular surface of the tibia, are, 1st, the internal lateral, a large quadrilateral bundle, which descends obliquely backwards from the apex and from the surface of the internal malleolus, to be attached to the internal part of the astragalus and os calcis; 2nd, the external lateral, a rounded and elongated bundle, extending from the extremity of the fibula to the middle and superior part of the os calcis: 3rd, the anterior

fibulo-tarsal, which passes obliquely from the top of the outer ankle to the astragalus, in front of the portion of the external surface of this bone, which is articulated with the fibula; 4th, the posterior fibulo-tarsal, extending obliquely from a depression, which is situated at the posterior part of the outer malleolus, to the posterior part of the astragalus; and 5th, the tibio-tarsal, formed by irregular fibres, directed obliquely downwards and outwards, from the anterior surface of the lower extremity of the tibia to the front of the articular pulley of the astragalus. The tendons of the flexor and extensor muscles of the foot surround this joint, as we have before said, and thus contribute to strengthen it. From this arrangement, it is evident that the tibio-tarsal articulation only allows of the extension and flexion of the foot: for the astragalus, bounded on the sides by the malleoli and lateral ligaments, can only move as far inwards and outwards as the ligament of the tibio-fibular articulation will allow it. The lateral motions by which the sole of the foot is turned inwards or outwards, are not connected with this articulation, but with that of the astragalus with the scaphoid and os calcis, and of the os calcis with the cuboid. But, in violent inversion or eversion of the foot, this action is not supported alone by the articulation of the astragalus with the bones of which we have just spoken, but also by the ankle-joint; and it is on this account that the dislocation of the astragalus on the bones of the leg is sometimes complicated with that of this bone on the calcaneum and scaphoid. The foot is most frequently dislocated inwards, and this is easily explained, since the axis of the tibia has a slightly oblique direction from above downwards and from without inwards, in relation to the articular surface of the astragalus; and also, since the inner does not descend so far down as the outer malleolus. The fractures of the fibula may also be produced by a violent inversion or eversion of the foot; in fact, this bone does not serve to transmit the weight of the body to the astragalus, but to hinder this bone from experiencing lateral deviations, and if a great force draws the foot, either inwards or outwards, the ex-

tremity of the fibula is strongly pressed, in the first case, by the astragalus, from within outwards; in the second, by the os calcis, from below upwards. But, if the ligaments which unite this bone to the tibia offer any resistance, it can be dislocated neither outwards nor upwards, and its natural curvature will be increased till the bone is fractured in the point where it offers the least resistance.

§ 310. The anterior surface, or head of the *astragalus*, is articulated with the scaphoid. It is round, convex, and supported by a kind of rough neck; the inferior surface of this bone presents two surfaces for articulation with the calcaneum. One, posterior and external, is large, concave, and directed backwards and inwards; the other, posterior and internal, is slightly convex. At the superior surface of the *os calcis*, we also observe two articular surfaces corresponding to those which we just mentioned. The anterior is narrow, long, slightly convex, and situated on an eminence called the small process of the calcaneum: the posterior, large, convex, and directed forwards and outwards, occupies the middle part of the bone, and is separated from the former by a deep and rough sulcus. It is in this spot that the interosseous ligament is attached, which ascends from thence into an analogous groove situated between the two articular depressions on the inferior surface of the astragalus. An external ligament extends from the base of the external depression of this bone to the outer surface of the calcaneum; and a posterior ligament, joined in part to the sheath of the tendon of the long flexor of the great toe, is attached to the posterior part of the astragalus, and passes obliquely inwards on the os calcis. Lastly, the lateral ligaments of the ankle-joint contribute to strengthen the articulation of the astragalus with the os calcis. The posterior part of the superior surface of the calcaneum does not present any thing remarkable; its posterior surface is convex, and gives attachment inferiorly to the tendo Achillis: it is always between this spot and the articulation of the os calcis with the astragalus that this bone is broken, at least when the fracture is not produced by a direct cause; for, from the violent contraction of the

extensor muscles of the foot, this bone represents a lever of the second order, and it is this part of the bone which is situated between the power applied and the resistance.

The inferior surface of the os calcis is rather narrow, and presents, posteriorly, two tuberosities, which serve for the insertion of the superficial muscles of the sole of the foot. Its external surface, in a great measure covered only by skin, is crossed by two sulci, into which the tendons of the peronei muscles glide. Its internal surface, concave from behind forwards, forms an arch, which lodges several plantar tendons, nerves, and vessels. When this arch is little developed, and consequently, when the whole sole of the foot rests on the ground, progression becomes difficult, on account of the pressure of the nerves and other soft parts situated in this part. It is for this reason a flat foot is one of the mal-formations admitted as a ground of exemption from military service. The anterior surface of the calcaneum is convex from above downwards, slightly concave laterally, and covered with cartilage, in order to be articulated with the cuboid.

§ 311. The astragalus and os calcis form the first row of the bones of the tarsus: the second is formed by the navicular, the cuboid, and three cuneiform. The *navicular*, of an oval form, presents posteriorly a large articular cavity, which lodges the head of the astragalus; anteriorly, three surfaces which are articulated with the cuneiform bones; internally, a tuberosity, to which the tibialis posticus is attached; and externally, a surface for articulation with the *cuboid*. This last bone, situated to the outer side of the navicular, presents, posteriorly, an articular surface, concave from above downwards, and convex transversely, which is attached to the anterior surface of the os calcis. The anterior surface of the cuboid is directed a little outwards, and is formed by two small depressions, which correspond to the two last bones of the metatarsus. Internally, it is united to the third cuneiform bone by a smooth surface, bounded anteriorly and posteriorly by ligamentous insertions. We sometimes also observe in this spot a small surface, which is articulated with the navicular:

lastly, its inferior surface presents an almost transverse groove, in which the tendon of the peroneus longus glides, and which is bounded posteriorly by a projection which gives attachment to the calcaneo-cuboidal ligament.

The transverse articular line, formed by the union of the astragalus with the navicular, and of the os calcis with the cuboid, is provided with several very strong ligaments, the principal of which are, 1st, that between the navicular and astragalus, extended from the neck of the astragalus to the superior surface of the navicular; 2nd, the superior calcaneo-cuboid, also situated on the dorsal surface of the foot; 3rd, the inferior calcaneo-navicular, almost fibro-cartilaginous, and attached to the small tuberosity of the os calcis and inferior surface of the navicular; 4th, the two inferior calcaneo-cuboid; and 5th, the external calcaneo-scaphoid, which is attached to the internal and anterior part of the calcis, and to the external and inferior part of the navicular, and which completes, with the inferior calcaneo-scaphoid, the cavity which receives the head of the astragalus. When the foot is flexed, this projection is situated nearly on the same level as the anterior extremity of the calcaneum; but when the limb is extended, this last bone almost always passes beyond the former about a quarter of an inch at least. Hence, semi-flexion is the most convenient position for amputation of the foot at this joint, the exact position of which may be easily ascertained by the assistance of the directions given at the commencement of this chapter. As the navicular surrounds the head of the astragalus, and extends towards the inner ankle, it would be impossible to penetrate into this articulation, by carrying the knife directly from within outwards. The operator must, on the contrary, follow the direction of a line passing from the posterior and internal surface of this bone to the point of junction of the posterior with the middle third of the fifth bone of the metatarsus. After having dislocated the foot, and divided with the point of the knife the ligaments of which we have just spoken, the surgeon must pass the instrument between the inferior surfaces of the navicular and cuboid, and the soft parts

of the sole of the foot, from which he saves the flap to cover the stump. But he must carefully avoid the tuberosities of the inferior surface of the navicular, the cuboid, the first and third bones of the metatarsus; and also make the flap longer internally than externally, on account of the greater thickness of the foot in the former than in the second direction.

§ 312. *The three cuneiform bones* are articulated with the navicular posteriorly, and with the cuboid externally. The anterior surface of the first of these bones (when counting from within outwards) is slightly convex, and directed a little inwards; it is articulated with the first metatarsal bone. That of the second cuneiform, situated more posteriorly, is triangular, slightly convex, and articulated with the second bone of the metatarsus. Lastly, that of the third cuneiform is flattened, and projects a little beyond the middle, to be articulated with the third metatarsal bone. The two last bones of the metatarsus are articulated with the two surfaces on the anterior portion of the cuboid.

§ 313. *The bones of the metatarsus*, five in number, form the third row of the bones of the foot; each presents a body and two extremities. The first metatarsal bone is the shortest and largest: its posterior extremity presents an oval and slightly concave articular surface, from the circumference of which passes inferiorly a projection, to which the peroneus longus is attached. The tarsal extremity of the second bone of the metatarsus is situated between the three cuneiform, and presents three surfaces for this articulation; one, in the centre, is directed backwards, and the lateral one, inwards and outwards. The posterior extremity of the third metatarsal bone is almost plane, and directed a little inwards; that of the fourth is a little convex, and presents, externally, a very projecting tuberosity, which gives attachment to the peroneus brevis, and which serves as a guide for ascertaining the exact position of the outer extremity of the tarso-metatarsal articulation. The internal extremity of this articulation is situated at about three-quarters of an inch in front of the external, and is not difficult to find. Hence, in the partial amputation of the foot in this spot, the incision must be begun on this

side. The exact knowledge of the direction of the different surfaces which contribute to form the tarso-metatarsal articulation, is of the greatest importance in this operation; on which account we think that the following details, given on this subject by M. Lisfranc, will not be found altogether uninteresting:—The direction of the outer part of this articulation may be represented by a curved line about an inch long, directed from without inwards, and from behind forwards, beginning at the middle part of the outer edge of the anterior surface of the cuboid, and terminating at about one-third of an inch nearer the nails, at the middle of the outer edge of the superior surface of the third cuneiform bone. It is, consequently, in this direction, that the knife must be first carried for disarticulating these bones; but the third cuneiform bone, extending generally about half a line beyond the internal and superior part of the dorsal surface of the cuboid, it is necessary to carry the knife a little forwards, to reach the spot between this and the third metatarsal bone. At this spot, the knife must be carried to the inner extremity of the articulation, the direction of which is oblique, and follows that of a line drawn from the anterior, superior, and internal angle of the first cuneiform to the centre of the fifth metatarsal bone. Lastly, the threefold articulation of the second bone of the metatarsus is at first directed completely backwards, then almost transversely outwards; and lastly, a little forwards and outwards.

The ligaments which unite the bones of the second row of the tarsus with those of the metatarsus, may be divided into dorsal, plantar, and interosseal; the latter are three in number. One is attached to the first and second cuneiform bones, on one hand, and to the corresponding surfaces of the two first metatarsal, on the other; the second is situated between the two last cuneiform, and the second and third bones of the metatarsus. The last is situated between the third and fourth of these bones, the third cuneiform, and cuboid. It is of great importance to know the situation of these ligaments, which powerfully contribute to keep the bones in contact; for, by dividing them successively with the

point of a knife, the bones of the metatarsus are disarticulated with the greatest ease.

§ 314. The articulations of the bones of the metatarsus with each other very much resemble those of the metacarpus. Their posterior extremities (with the exception of the first) are united by surfaces covered with cartilage, and lined with synovial membranes, and are kept in contact by palmar and dorsal ligaments; their anterior extremities are not in immediate contact, but are united together by a transverse ligament. As in the hand, the disarticulation of the first and fifth metatarsal bones is much easier than that of the three middle, but it is not the case with the first; for the thickness and transverse direction of the anterior surface of the first cuneiform prevent the flap being immediately applied, and a kind of space is left where the blood and pus accumulate.

The phalanges of the toes are of the same number as those of the fingers, and present nearly the same arrangement. It is, however, essential to recollect, that the base of the second and third phalanges presents, superiorly, a projection formed by a flattened tubercle, and that they can consequently be much more easily disarticulated than that of the second and third phalanges of the fingers.

THE END.

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